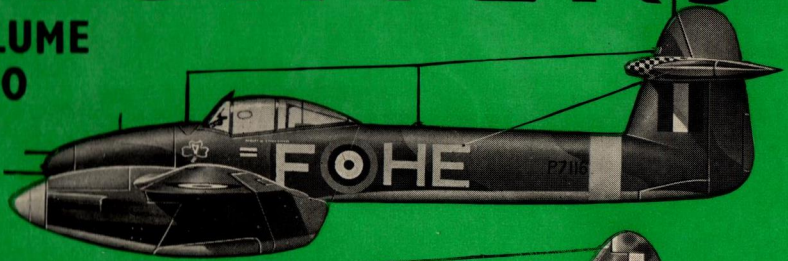
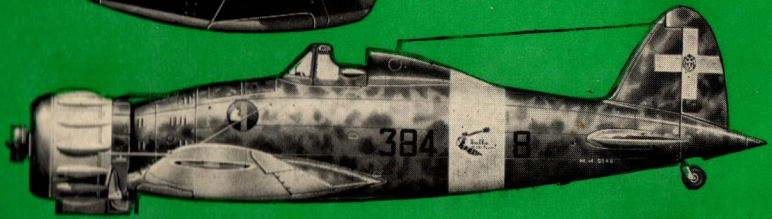
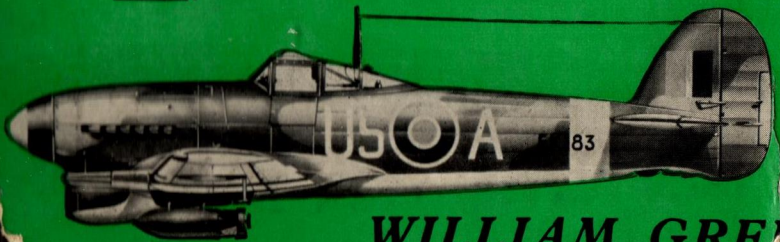
WAR PLANES OF THE SECOND WORLD WAR

FIGHTERS

VOLUME TWO







WILLIAM GREEN

FIGHTERS VOLUME TWO

DOUBLEDAY

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WAR PLANES OF THE SECOND WORLD WAR

by

William Green

F I G H T E R S

Volume II

Great Britain

Italy

WAR PLANES FIGHTERS 2 DOUBLEDAY

WAR PLANES OF THE SECOND WORLD WAR

FIGHTERS

VOLUME TWO

WILLIAM GREEN

With Drawings by Dennis I. Punnett

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INTRODUCTION

The astonishing transformation in fighter design brought about by the accelerating effects of war was such that it would hardly be any exaggeration to suggest that the early fighter-versus-fighter encounters over the Western Front in 1939–40 differed as radically from those that took place in German skies five years later as did a cavalry charge at Waterloo and a tank battle in the Western Desert. In those five years fighter firepower, usually confined to a few rifle-calibre machine guns in 1939, grew to batteries of cannon, sometimes of 30-mm. calibre and larger, and the day of the air-to-air missile dawned. In the close-support role, fighters became devastating weapons capable of changing the course of a battle. The radar-equipped night fighter emerged, and the turbojet began to change the whole fighter scene. The performance advances of those years are best illustrated by a comparison of the 324 m.p.h. maximum speed of the Hurricane of 1939 with the 493 m.p.h. of the Meteor III of 1944.

In this, the second fighter volume of *War Planes of the Second World War*, the fighters and fighter-bombers of Great Britain and Italy are detailed, and as with the first volume, every attempt has been made in the pages that follow to provide the most complete information in condensed and easily assimilable form. Fighter development in Great Britain during the war years closely paralleled that in Germany in the constant struggle to achieve technical superiority. As with the Bf 109 and Bf 110 with which the Luftwaffe opened the air war, the R.A.F.'s Hurricane and Spitfire remained in first-line service to the end; supplemented but never entirely supplanted by later designs. Some of these later designs, such as the Typhoon, were pressed into service too hurriedly, suffering teething troubles and setbacks which earned for them unenviable reputations, while others, such as the Mosquito, surpassed the most sanguine of expectations from the outset of their careers.

The Italian fighters employed operationally were often derided by their enemies for propaganda purposes but, with few exceptions, they were highly manœuvrable aircraft possessing beautifully co-ordinated controls—pilots' aeroplanes in every respect. When the Regia Aeronautica joined combat its fighters were not so completely equipped as their British and German contemporaries, and they were seriously deficient in firepower, but Italian designers rapidly remedied the defects in their fighters, producing such types as the Macchi C.205V, the Reggiane Re.2005 Sagittario, and the Fiat G.55 Centauro which bore comparison with the best fighters of the other combatants. The Italian aircraft industry was also responsible for the development of what were probably the only completely successful lightweight piston-engined fighters, culminating in the excellent S.A.I.403 Dardo, but were incapable of evolving effective mass production techniques and, in consequence, were unable to keep abreast of attrition in the Regia Aeronautica's fighter squadrons.

The pattern of the pages that follow conforms with that set by the first volume in which details were recorded of both fighters which actually saw service with their respective air arms, and those which for various reasons failed to enter service, and their contents owe much to the generous assistance of Countess Timina Caproni di Taliedo, Giorgio Bignozzi, Dr. Rosario Abate, and Giorgio Apostolo, and to F. G. Swanborough who kindly read the proofs of the British section.

February 1961 William Green

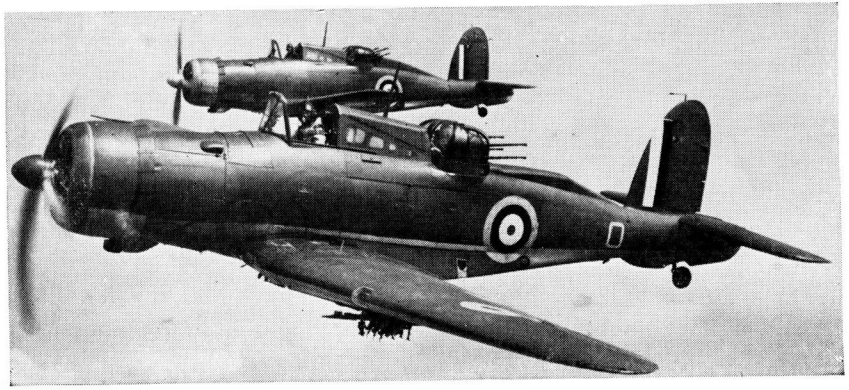
BLACKBURN ROC

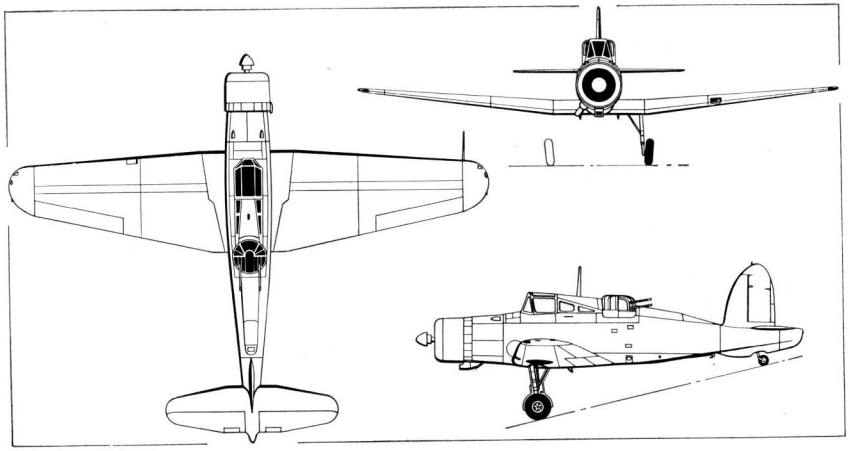
GREAT BRITAIN

It would be idle to deny that the two-seat single-engined turret fighter concept was a failure. The weight and drag of a power-driven gun turret seriously impaired performance, and the idea of bringing a quartette of machine guns to bear in broadside attacks on enemy bombers proved tactically unsound. The Roc, contemporary with the Boulton Paul Defiant and its shipboard equivalent, was the Fleet Air Arm's first aircraft to be equipped with a power-driven turret, and after a brief period in first-line service during which it never operated from an aircraft carrier, it was withdrawn, subsequently serving as a trainer and target-tug.

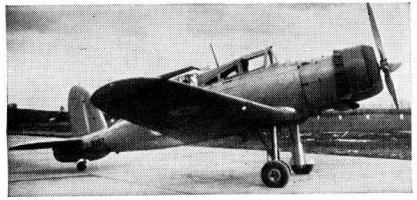
The Roc was essentially a fighter variant of the Blackburn Skua shipboard dive-bomber, and the design and construction of the two aircraft were fundamentally the same. Meeting the requirements of specification 0.30/35, the Roc was ordered on April 28, 1937, and the contract for 136 aircraft was sub-contracted to Boulton Paul Aircraft. The Roc differed from the Skua in having a slightly wider fuselage in order to accommodate a Boulton Paul "A" power-driven turret with its four 0.303-in. Browning guns, and increased wing dihedral. The first three production aeroplanes (L3057-3059) served as prototypes, and the first of these made its initial flight on December 23, 1938. The third machine (L3059) was experimentally fitted with twin floats to specification 20/37, being completed in this form in December 1939, and a further 133 Rocs (L3060 to L3192 inclusive) were built, production terminating in August 1940.

The Roc entered service with No. 806 Squadron in February 1940, this unit operating





four Rocs together with eight Skuas, and in June six Rocs joined No. 801 Squadron, but after a few months No. 802 re-equipped with Fulmars and, in 1941, No. 801 received Sea Hurricanes. The remaining Rocs were employed for various second-line duties, some having their turrets removed.



The first production Roc (L3057) which flew on December 23, 1938 for the first time.

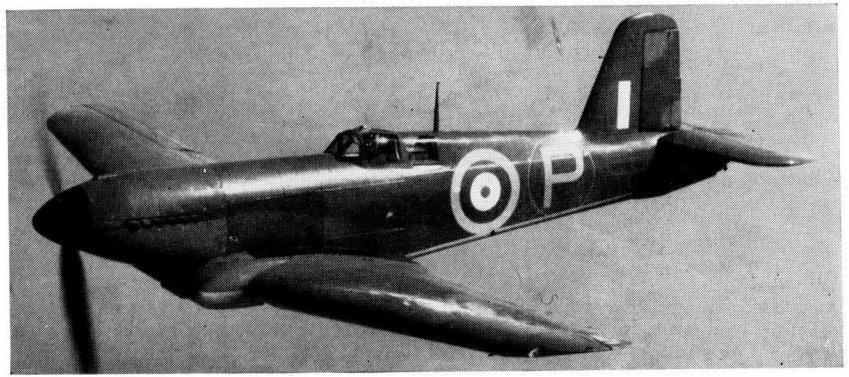
Type: *Two-seat Shipboard Fighter.* **Power Plant:** *One 905 h.p. Bristol Perseus XII nine-cylinder radial air-cooled engine.* **Armament:** *One Boulton Paul "A" power-driven turret containing four 0.303-in. Browning machine guns with 600 r.p.g. plus eight 30-lb. bombs on underwing racks.* **Performance:** *Maximum speed, 196 m.p.h. at 6,500 ft; cruising speed, 135 m.p.h. at 13,000 ft.; range, 610 mls.; endurance, 4.5 hrs.; initial climb rate, 1,130 ft./min.; service ceiling, 15,200 ft.* **Weights:** *Empty, 6,121 lb.; loaded, 8,800 lb.* **Dimensions:** *Span, 46 ft. 0 in.; length, 35 ft. 7 in.; height, 12 ft. 1 in.; wing area, 310 sq.ft.*

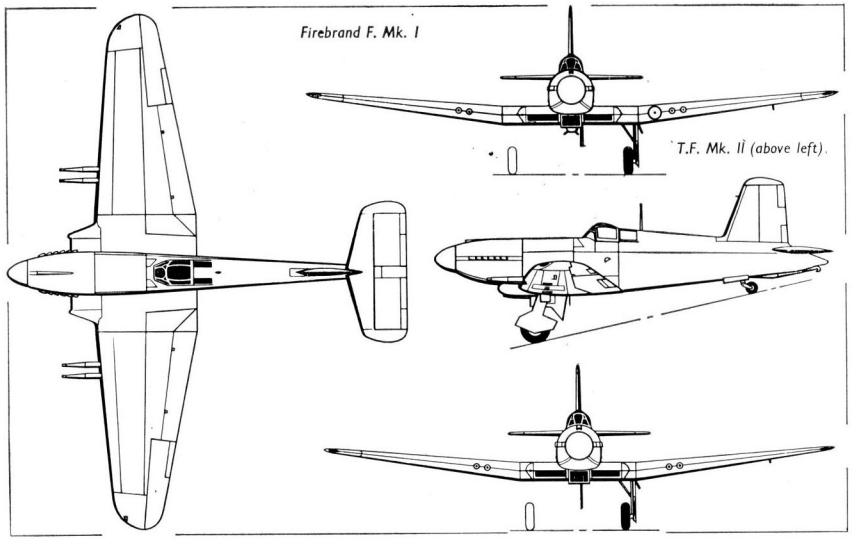
BLACKBURN FIREBRAND I AND II — GREAT BRITAIN

Conceived as a short-range shipboard interceptor fighter in 1940, the Firebrand suffered a succession of changes during which a radial air-cooled engine supplanted the liquid-cooled horizontal-H engine for which it had been designed and the primary role of the aircraft was changed. The prolonged gestatory period resulting from these changes delayed the service introduction of the Firebrand until 1945, and the type was too late to be employed operationally.

The Blackburn B.37, as the Firebrand was initially designated, was designed to meet the requirements of specification N.11/40 which demanded a Sabre-engined, cannon-armed short-range interceptor fighter suitable for shipboard operation. The first design conference took place on July 25, 1940, and a mock-up of the projected fighter was completed during the following September. The first B.37 prototype (DD804) was flown on February 27, 1942, powered by a 2,305 h.p. Sabre III engine, being followed in July by a second prototype (DD810) which was fitted with a wing-mounted armament of four 20-mm. cannon and full military equipment, this undergoing deck-landing trials aboard H.M.S. *Illustrious* in February 1943. Well before this event, however, the Admiralty had reached the decision that the aircraft did not offer a sufficient advance in performance over that of the Seafire to warrant production as an interceptor. Nevertheless, the considerable load-carrying ability of the Blackburn aircraft suggested that

The first B.37 Firebrand prototype (DD804) which was completed as a short-range shipboard interceptor.

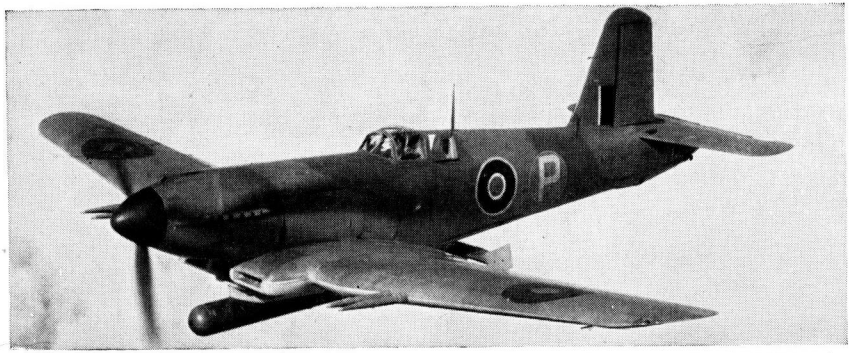




it could well be developed as an admirable torpedo-strike fighter, and subsequent development was therefore directed towards this end. About the same time, it was rendered necessary to find an alternative engine as the R.A.F. possessed priority for Sabre production for the Typhoon. As the Centaurus eighteen-cylinder two-row air-cooled radial was just coming into production and offered the required power, this was selected as the definitive power plant for the Firebrand.

A third prototype Firebrand I (DD815) was flown, and this was followed by nine production Firebrand I fighters all powered by the Sabre III (DK363-371). Used for experimental purposes, the Firebrand Is carried four 20-mm. cannon and could be fitted with underwing racks for two 500-lb. bombs.

The transformation of the Firebrand I into the Firebrand II torpedo-strike fighter was made possible by widening the wing centre section by approximately eighteen inches to permit an 18-in. torpedo to be carried between the wheel wells. The second prototype (DD 810), which had suffered a mishap as a result of an oil pipe bursting in flight and the engine



The prototype Firebrand T.F.II (NV636) was originally the second prototype Mk.I (DD810) but was allocated a new serial number when it was rebuilt after a forced landing.

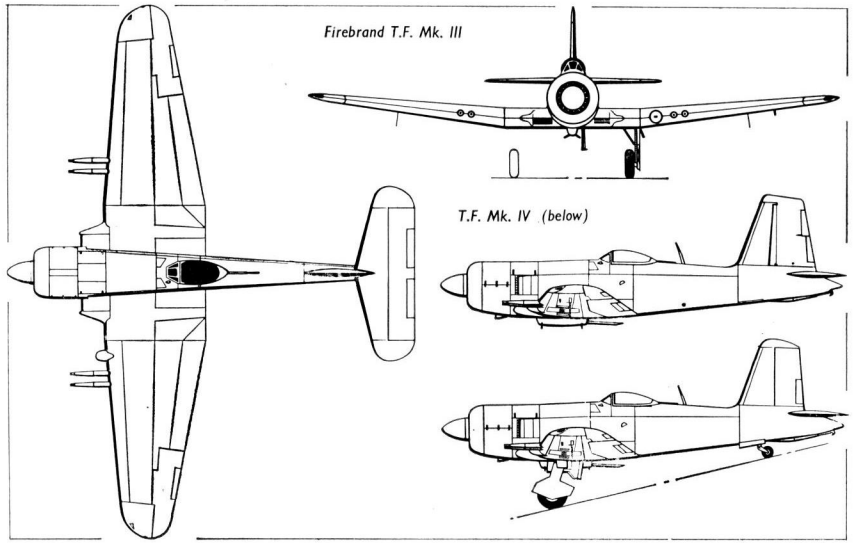
seizing, was rebuilt as the prototype Firebrand II. Allocated a new serial number (NV636) and equipped to carry a torpedo under the widened centre section, the modified aircraft flew on March 31, 1943, carrying a torpedo for the first time two days later, on April 2nd, thus gaining the distinction of becoming the world's first single-seat torpedo-carrier monoplane. Twelve production Firebrand IIs (DK374-385) were produced, and some of these later had their torpedo gear removed and rails for eight rockets fitted under the wings. Sabre-powered Firebrand IIs were issued to No. 708 Squadron, a shore-based unit, in the autumn of 1944. In mock dog-fights with Seafires, the Sabre-powered Firebrands could easily out-dive their opponents, but on December 21, 1943, the prototype Centaurus-powered Firebrand III had flown, and the aircraft's subsequent development was linked to the radial air-cooled engine, no further Sabre-powered machines being completed.

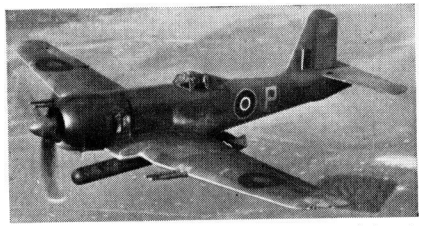
The following specification relates to the Firebrand II, figures in parentheses relating to the Firebrand I interceptor.

Type: *Single-seat Torpedo-strike (Interceptor) Fighter.* **Power Plant:** *One* 2,305 *h.p. Napier Sabre III twenty-four-cylinder horizontal-H liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano cannon with* 200 *r.p.g. plus one* 1,850-*lb. torpedo (two* 500-*lb. bombs).* **Performance:** *Maximum speed,* 314 (322) *m.p.h. at sea level,* 355 (357) *m.p.h. at* 18,000 *ft., (with torpedo)* 348 *m.p.h. at* 18,000 *ft.; initial climb rate,* 2,300 (2,250) *ft./min., (with torpedo)* 1,900 *ft./min.; maximum cruising speed,* 274 (284) *m.p.h.* at 10,000 *ft.; endurance,* 3.2 *hrs.; range,* 767 (805) *mls.* **Weights:** *Loaded,* 15,049 (13,625) *lb.* **Dimensions:** *Span,* 51 ft. 3½ in. (50 *ft.* 0 *in.); length,* 38 *ft.* 2 *in.; height,* 13 *ft.* 4 *in.; wing area,* 381.5 *sq.ft.*

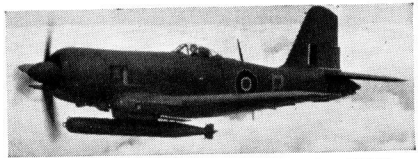
Owing to the limited supply of liquid-cooled Sabre engines and the priority in their supply enjoyed by the R.A.F., the decision had been taken in 1942 to adapt the Firebrand to take the Centaurus air-cooled radial, and two airframes (DK372-373)—originally to have been the tenth and eleventh production Firebrand Is—were chosen for adaptation as prototypes for the Centaurus-powered Firebrand III to specification S.8/43, the first of these flying on December 21, 1943. The conversion involved considerable complication. The replacement of a liquid-cooled engine by a large air-cooled radial was no simple task, and in the case of the Firebrand the conversion was rendered the more difficult by the fact that the lines of the fuselage had been kept as slim as possible for use with the Sabre. However, few major changes to the fuselage structure were found to be necessary.

Twenty-four production Firebrand IIIs (DK386-409) followed the two prototypes in



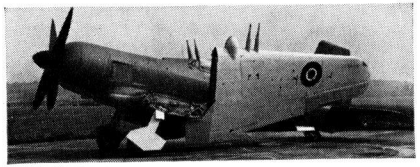


First prototype Firebrand III, DK372 (above).



(Above) Second prototype Mk.III, DK373.

(Above) Firebrand IV, EK730 and (below) EK668.



1944, powered by the Centaurus VII or XI, but the principal production model was the Firebrand IV powered by the Centaurus IX, 102 examples of which were built (EK601-635, EK653-694 and EK719-740). Apart from the engine change, the Firebrand IV differed from its predecessor principally in having a very much larger fin and aerodynamically balanced rudder resulting from some inadequate directional control experienced with the Firebrand III. It also introduced wing-mounted air brakes and a two-position torpedo mounting.

The first Firebrand IV flew on May 17, 1945, and in the following September No. 813 Squadron reformed with this type. Production continued into the post-war years with the Firebrand V, sixty-eight examples of which were built, many Mk.IVs being brought up to Mk.V standards, the type eventually going to sea with Nos. 810 and 813 Squadrons aboard H.M.S. *Implacable* in October 1947.

The following specification relates to the Firebrand T.F.Mk.IV, figures in parentheses relating to the T.F.Mk.III.

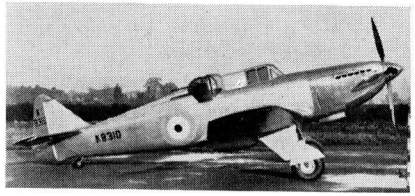
Type: *Single-seat Torpedo-strike Fighter.* **Power Plant:** *One 2,520 h.p. Bristol Centaurus IX (XI) eighteen-cylinder radial air-cooled engine.* **Armament:** *Four 20-mm. Hispano cannon with 200 r.p.g. plus one 1,850-lb. torpedo, two 1,000-lb. bombs or sixteen 60-lb. rocket projectiles.* **Performance:** *Maximum speed, 350 m.p.h. at 13,000 ft., (with torpedo) 342 m.p.h. at 13,000 ft.; range, 745 mls. at 256 m.p.h. at 10,000 ft., 627 mls. at 289 m.p.h. at 10,000 ft.; endurance, 2.9 hrs.; initial climb rate, 2,600 ft./min., (with torpedo) 2,200 ft./min.; service ceiling, 28,500 ft.* **Weights:** *Empty, 11,456 lb.; loaded, 15,671 (15,753) lb.* **Dimensions:** *Span, 51 ft. 3½ in.; length, 39 ft. 1 in. (38 ft. 10 in.); height, 15 ft. 2 in.; wing area, 381.5 sq.ft.*

BOULTON PAUL DEFIANT

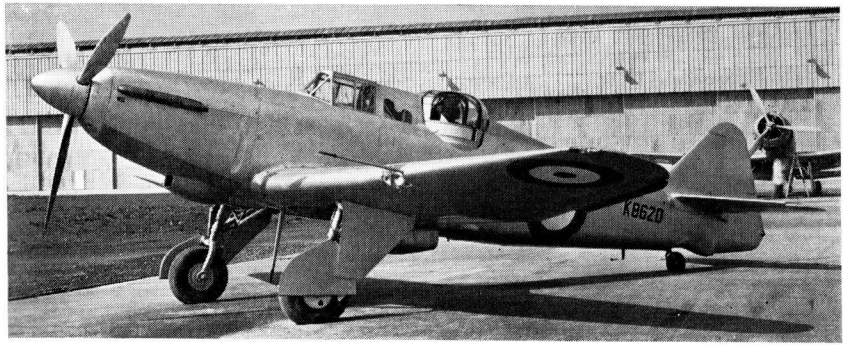
GREAT BRITAIN

The turret fighter—a fighter wherein the entire armament was concentrated in a power-driven turret—was conceived in 1935, resulting in the issue of specification F.9/35. To meet the requirements of this specification, Boulton Paul evolved the P.82 Defiant which, despite a number of exceptional qualities, was to be somewhat short-lived. Although an excellent flying machine, the Defiant was undeniably slower and less manoeuvrable than its single-seat contemporaries. Despite the compactness of its turret it was impossible to eliminate the high drag of this massive piece of equipment, and although the Defiant was not very much larger than the Hurricane, wing and power loadings were substantially higher, and it was soon found unsuited for fighter-versus-fighter combat with the result that it was withdrawn from daylight operations and employed as a night fighter.

The first prototype Defiant (K8310) was flown for the first time on August 11, 1937 powered by a 1,030 h.p. Merlin I engine. This was followed by a second prototype (K8620) with a Merlin II, and the first production aeroplane (L6950) to specification 5/37 flew on July 30, 1939. Structurally, the Defiant was of conventional design and was, for a two-seater, a small aeroplane. Mounting four belt-fed Brownings, the Boulton Paul turret was a removable, self-

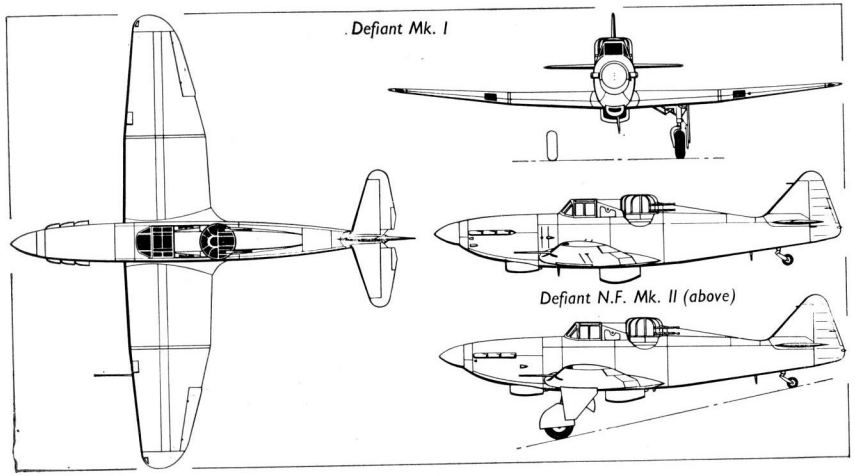


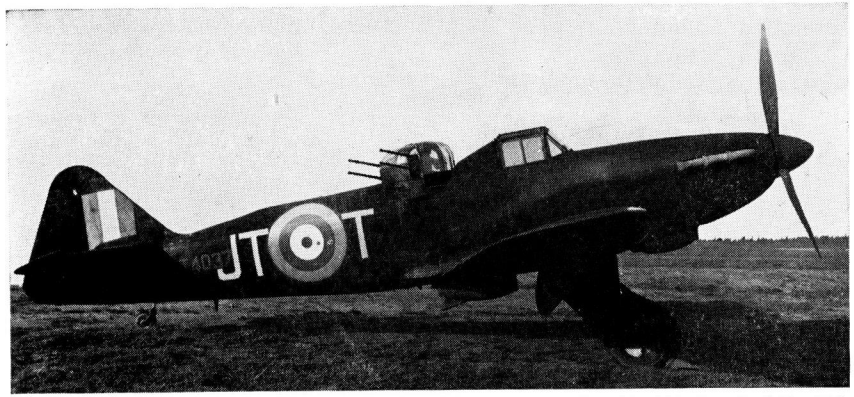
(Right) The first Defiant prototype, K8310, and (below) the second prototype, K8620.



contained unit, the whole of its hydraulic system being part of the turret itself. Drag from the turret was reduced to some extent by means of 'disappearing fairings' both fore and aft of the turret. Constructed of spruce and three-ply, these fairings hinged downwards to enable the guns to be traversed, being operated by pneumatic jacks actuated by cams fitted to the turret.

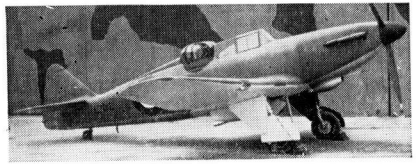
The first production Defiant Is were delivered to No. 264 Squadron at Manston, who took their fighters into action in May 1940 over Dunkirk. By the end of the month the squadron had claimed sixty-five "kills", no fewer than thirty-eight of these being gained on the 29th. Initially, it appeared that the new tactical concept introduced by the Defiant had been vindicated, but it soon became apparent that the Luftwaffe's fighters had mistaken No. 264's Defiants for Hurricanes, diving on the supposedly defenceless tails of the British fighters only to be greeted by a withering concentration of fire. The Luftwaffe learned rapidly from its mistake, however, attacking the Defiants head-on with the result that the British fighters were decimated, forcing the Defiant's withdrawal from daylight operations after No. 264 and the second Defiant squadron, No. 141, had participated briefly in the "Battle of Britain". At about this time, incidentally, Boulton Paul proposed a single-seat version of the Defiant with four wing-mounted guns, but this project was not proceeded with, only a mock-up being completed.



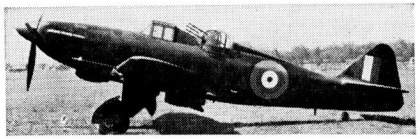


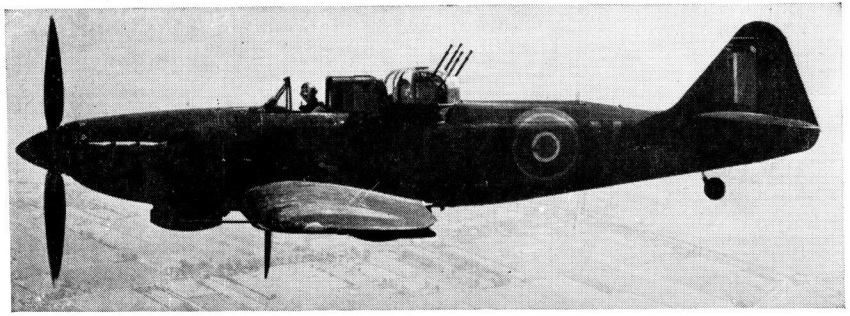
(Above) A Boulton Paul Defiant I of No. 256 Squadron in October 1941, and (below) the 62nd production Defiant Mk.I.

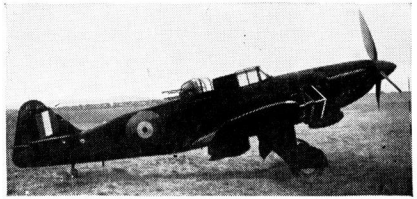
During 1941, the Defiant was successfully converted for night fighting, and eventually most machines were fitted with A.I.Mk.IV or or VI radar, equipping thirteen home-based night-fighter squadrons. Seven hundred and twelve Defiant Is were completed in addition to the two prototypes. One (L6968) was used for army co-operation trials at Odiham in January 1940. Another (N3514) was fitted with a 1,200 h.p. Merlin 46 and, with turret removed, was used for engine performance trials at the R.A.E. in 1942. A late production Defiant I (T4106) was shipped to the U.S.A. for trials at Wright Field, and two (N1550 and N1551) were fitted with redesigned engine mountings, a 1,280 h.p. Merlin XX, redesigned radiator, additional fuel tankage, a pressurized fuel system, and a slightly enlarged rudder as the prototypes of the Defiant II. The first of these flew on July 20, 1940, and the first of seven retrospective conversions of Mk.Is to



A late production Defiant I, T4106 (below) at Wright Field for evaluation.







(*Above*) *A Defiant II of No.* 151 *Squadron and* (*left*) *an A.I.-equipped Defiant II* (*AA*370) *in August* 1941.

Mk.II standards on the production line (AA363) flew in February 1941, being followed by 200 Defiant IIs (commencing AA370). A number of Defiant IIs were fitted with A.I. Mks.IV or VI as night fighters, and from April 1942, some 150 of the Defiant IIs were converted for target-tug duties. About 140 Defiant Is were also converted for the target-tug role with their turrets removed as Defiant T.T. IIIs. A further 140 machines basically similar to the Mk.II were built from the ground up as Defiant T.T.I target-tugs, bringing total production to 1,060 Defiants when deliveries ceased in February 1943, orders for a further 430 machines having been cancelled. In May 1945, one Defiant II (DR944) was used for trials with Martin-Baker ejector seats.

The following specification relates to the Defiant I, figures in parentheses referring to the Defiant II.

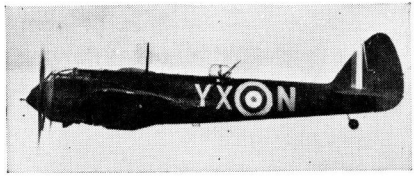
Type: *Two-seat Night Fighter.* **Power Plant:** *One* 1,030 (1,280) *h.p. Rolls-Royce Merlin III* (*XX*) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Four* 0.303-*in. Browning machine guns with* 600 *r.p.g. in Boulton Paul A.Mk.IID power-operated turret.* **Performance:** *Maximum speed,* 304 (303) *m.p.h. at* 17,000 (12,000) *ft.,* (313) *m.p.h. at* (19,000) *ft.; cruising speed,* 259 *m.p.h. at* 15,000 *ft.; range,* 465 *mls.; endurance,* 1.78 *hrs.; time to* 15,750 *ft.,* 8.5 *min.; service ceiling,* 30,350 *ft.* **Weights:** *Empty,* 6,078 (6,282) *lb.; normal loaded,* 8,318 (8,424) *lb.; maximum,* 8,600 *lb.* **Dimensions:** *Span,* 39 *ft.* 4 *in.; length,* 35 *ft.* 4 *in.; height,* 11 *ft.* 4 *in.; wing area,* 250 *sq.ft.*

BRISTOL BLENHEIM IF AND IVF

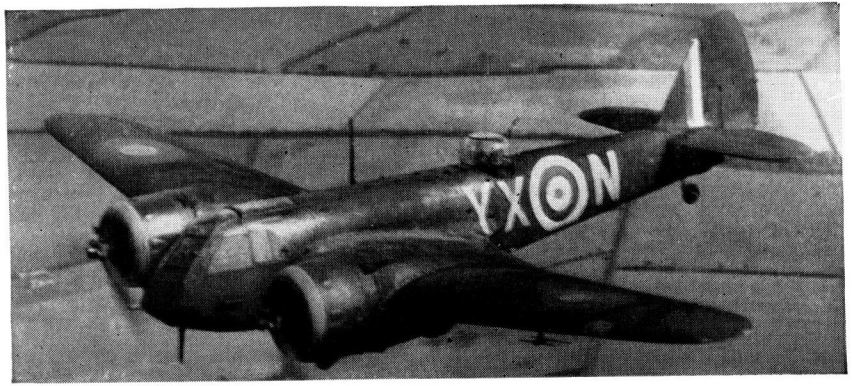
GREAT BRITAIN

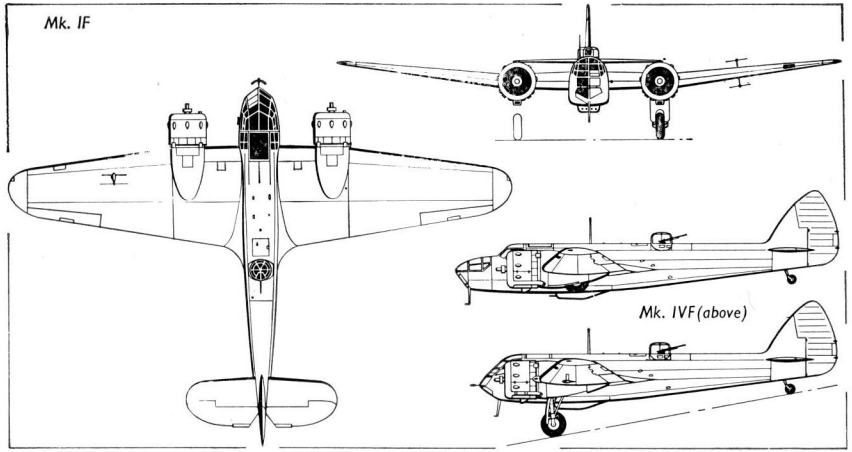
Although the Blenheim lacked the speed necessary for a fully effective fighter, it performed a useful service as an interim night fighter and intruder and anti-shipping strike fighter, and largely pioneered airborne interception radar. The conversion of some two hundred Blenheim I three-seat light bombers as night fighters was initiated in 1938, the conversion comprising the attachment of a gun pack containing four 0.303-in. Browning guns with 500 r.p.g. beneath the forward fuselage and a reduction in the transparent panelling in the lower part of the nose. The conversion kits were supplied by the Southern Railway's Ashford factory, and as the Blenheim IF, eleven home-based fighter squadrons and three squadrons overseas flew this interim fighter until the advent of the Beaufighter.

The Blenheim IF fighters of Nos. 25 and 601 Squadrons attacked the Borkum seaplane base on November 28, 1939, and on the night of December 21-22, Blenheim IFs of No. 23 Squadron undertook the first night intruder sortie of the war. Until the delivery of the Beaufighter, the Blenheim IF was the only



(*Below and above, right*) *An A.I-equipped Blenheim IF night fighter of No.* 614 *Squadron.*





R.A.F. fighter capable of carrying the 1.5-metre A.I.Mk.IV interception radar and, fitted with this equipment, aircraft of this type served throughout the Luftwaffe's night offensive of 1940-41, scoring their first success with this revolutionary development on July 22, 1940.

A similar gun pack to that carried by the Blenheim IF was also fitted to a number of long-nose Blenheim IVs in 1940 for service with R.A.F. Coastal Command. Designated Blenheim IVF, this type was used as an anti-shipping strike fighter by ten Coastal Command squadrons. It was also used by two Fighter Command squadrons for a brief period.

The following specification relates to the Blenheim IVF fighter. Performance details for the Blenheim IF are generally similar.

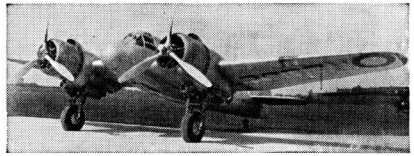
Type: *Two-seat Long-range Fighter.* **Power Plants:** *Two* 840 *h.p. Bristol Mercury XV nine-cylinder radial air-cooled engines.* **Armament:** *Four* 0.303-*in. Browning machine guns with* 500 *r.p.g. in ventral pack, one* 0.303-in. *Browning with* 400 *rounds in wing, and one* 0.303-*in. Vickers "K" gun in dorsal turret.* **Performance:** *Maximum speed,* 260 *m.p.h. at* 12,000 *ft.; maximum cruising speed,* 220 *m.p.h. at* 15,000 *ft.; range,* 1 460 *mls. at* 180 *m.p.h.; initial climb rate,* 1,500 *ft./min.; time to* 15,000 *ft.,* 15 *min.; service ceiling,* 24,600 *ft.* **Weights:** *Empty,* 9,200 *lb.; normal loaded,* 13,800 *lb.; maximum,* 14,500 *lb.* **Dimensions:** *Span,* 56 *ft.* 4 *in.; length,* 42 *ft.* 7 *in.; height,* 9 *ft.* 10 *in.; wing area,* 469 *sq.ft.*

BRISTOL BEAUFIGHTER I–V

The Beaufighter was the result of a true piece of British improvisation and one of the most successful warplanes employed by any of the combatants. Conceived within a month of the Munich Crisis by L. G. Frise and his design team, the Beaufighter appeared at a time when it was most sorely needed, and to this aeroplane went most of the credit for the defeat of the Luftwaffe's night offensive against Britain of 1940–41. Thereafter, it operated in every major campaign of the war, continually adding to its laurels and emerging as one of the most versatile of aircraft.

The Type 156 Beaufighter was virtually a fighter variant of the Type 152 Beaufort general reconnaissance and torpedo-bomber, employing a considerable proportion of the components of the earlier aeroplane. The economy of the proposal offered obvious advantages at a time when the aircraft industry was struggling to meet the vast requirements of an immense rearmament programme, and little more than eight months after the design had been initiated, the first of four prototypes (R2052) made its initial flight. This event took place on July 17, 1939—exactly two weeks after a production contract for 300 machines had been placed to specification F.17/39—and the prototype was powered by a pair of two-speed supercharged Hercules radials. The main fuselage and the engine mounts were the only entirely new components, and official trials commenced at an all-up weight of 16,000 lb. at which a maximum speed of 335 m.p.h. was attained at 16,800 ft. All-up weight was later increased to 18,531 lb.

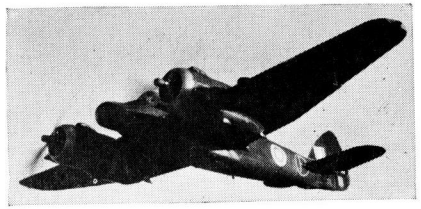
A second prototype (R2053), with detail changes and production Hercules II engines rated at 1,300 h.p. for take-off, had been delivered to the R.A.F. by the end of April 1940, and the third and fourth prototypes



(*Above*) *The first Beaufighter* (*R*2052) *as first flown and* (*below*) *after modifications.*

(R2054 and R2055) had joined the test programme by the end of May. With full operational equipment installed, performance was somewhat disappointing, and little improvement was expected to result from the installation of the Hercules III rated at 1,400 h.p. for take-off in production Beaufighters. A substantial increment in performance was expected to result from the installation of the Hercules VI, but as this engine was not immediately available, the 1,500 h.p. Hercules XI—a modified III operating on 100-octane fuel—was selected to power the initial production Beaufighter IF as an alternative to the Hercules III.

The Beaufighter IF carried an armament of four 20-mm. cannon in the lower portion of the fuselage nose and six 0.303-in. machine guns in the wings, two to port and four to starboard, although the first few machines off



(Above) A Beaufighter I of No. 604 *Squadron and (below, left), a Mk. I (X*7579*) with thimble nose, later adopted by the Beaufighter X.*

the assembly line at Filton had only the cannon installed. Servo ammunition feeds had replaced the drum feeds employed by the cannon of the first three prototypes—later a recoil-operated feed was standardised—and 1.5-metre A.I.Mk.IV radar was installed in the nose. In general, the Beaufighter handled well, although it could be tricky under certain circumstances, and there was a strong tendency to swing on take-off with the danger of flick rolling in the event of an engine cutting suddenly.

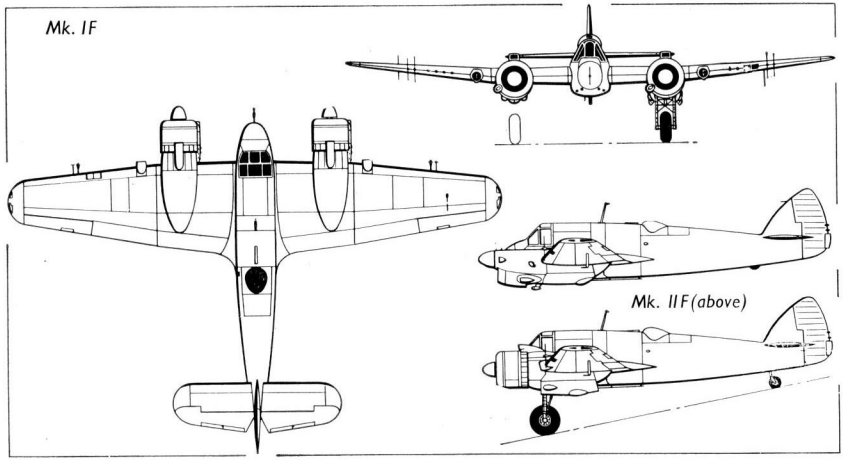
Five Beaufighter IFs were handed over to the R.A.F. on July 27, 1940, another five following on August 3rd, and Nos. 25 and 29 Squadrons each received a Beaufighter on September 2, 1940. No. 29 Squadron became fully operational on the Beaufighter on September 17th, with No. 25 Squadron following on October 10th. Nos. 600 and 640 Squadrons were meanwhile working up with the new fighter, and the latter gained the distinction of scoring the first Beaufighter "kill" on November 11th when a Ju 88A was destroyed with the aid of the A.I.Mk.IV radar. An indication of the rapidity with which production tempo built up is given by the fact that the 100th machine was completed at Filton on December 7, 1940, and the 200th Beaufighter was completed on May 10, 1941, by which time Bristol's new factory at Weston-super-Mare and the Fairey factory at Stockport had joined the production programme, the first Beaufighter from the latter plant (T4623) flying on February 7, 1941, being closely followed by the first machine from

Weston-super-Mare (X7540) on February 20th.

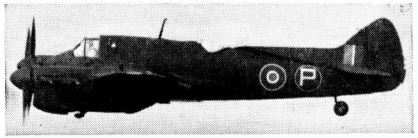
While priority was initially given to the re-equipment of the night-fighter squadrons with the Beaufighter, a pressing need had arisen for long-range day fighters in the Western Desert, and a number of machines were hurriedly fitted with desert equipment for No. 252 Squadron in the autumn of 1940. Their range was extended by the mounting of a 50 Imp. gal. Wellington tank on the fuselage floor, but this proved somewhat unsatisfactory, and later the extra range required was gained by fitting new wing tanks in the outboard panels as alternative installations to the machine guns.

Early in 1941, as a result of experiments with two of the first production batch of Beaufighters, a variant was evolved specifically for Coastal Command for shipping strikes and the protection of coastal shipping. Entering service with No. 143 Squadron in the spring of 1941, this variant, designated Beaufighter IC (the "C" suffix indicating "Coastal" as distinct from the "F" suffix applied to fighter variants), was provided with special Coastal Command radio and navigation facilities, including a folding chart table in the cockpit above the cannon feeds. Operating from the coasts of Norway to the Bay of Biscay, Coastal Command's Beaufighter ICs became progressively more important.

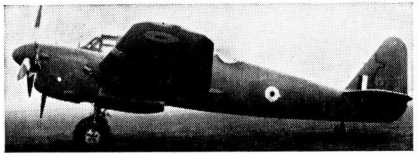
Numerous experiments were undertaken with Beaufighter Is. Centimetric A.I.Mk.VII



(*Above*) *R2268 with twin fins and rudders and* (*below*) *T3032 with an extended dorsal fin.*



(*Below*) *R2056 with redesigned vertical tail surfaces.*



(*Below*) *T3177 with Rolls-Royce Griffon IIBs.*

radar in a distinctive "thimble" nose was tested on X7579, and the fourth prototype (R2055) was fitted with two 40-mm. cannon—a Vickers "S" gun to starboard and a Rolls-Royce "BH" gun to port—in the fuselage and tested at Dunsfold during 1941. Another was engaged in developing the Youngman-Fairey bellows-type dive brake which was operated by means of a venturi intake under each wing.

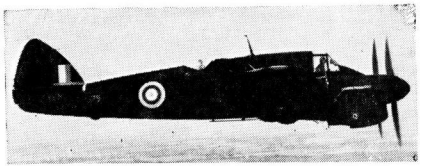
At an early stage in the Beaufighter's production an alternative Merlin-engined version, the Mk.II, was also ordered. Considerable demands were being made on the limited output of Hercules engines by the Short Stirling bomber, and it was envisaged that the Merlin-engined Beaufighter II should be produced in parallel with the Hercules-powered Mk.I until sufficient quantities of Hercules radials became available to fulfil all requirements. Three of the first production Beaufighters had been allocated to Rolls-Royce in 1939, and these subsequently served as prototypes for the Beaufighter II. One, R2062, was destroyed in an attack on Hucknall, but the others, R2058 and R2061, were fitted with Merlin X engines rated at 1,075 h.p. for take-off in October and December 1940. These were followed on March 22, 1941 by the first production Beaufighter IIF (R2270) with 1,280 h.p. Merlin XX engines.

The installation of Merlins resulted in some reduction in drag and a slight improvement in performance, maximum speed being boosted to 330 m.p.h., but the reduced side area ahead of the c.g. made the Beaufighter II rather unstable directionally. Some lack of stability had already been experienced with the Beaufighter I, and one (R2268) had flown with a broad-chord tailplane, and, later, twin fins and rudders in an attempt to overcome this fault. Eventually the introduction of a 12° dihedral on the Beaufighter IIF's tailplane was found to provide the answer, and this modification

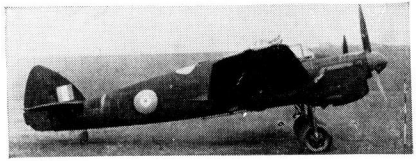
was adopted retrospectively and for all subsequent production aircraft. Another Beaufighter IIF (T3032) was tested with a dorsal fin extension which was later adopted for the Mk.X.

The second Beaufighter II prototype (R2061) was fitted and flown with special cowlings designed for the Exe engine, and a production machine (T3177) was flown with Griffon IIB engines. The Beaufighter IIF served primarily with night fighter squadrons on home-defence duties, but was also used by several Fleet Requirements Units of the Fleet Air Arm, including Nos. 721, 723, 775, 779 and 789 Squadrons. A total of 450 Beaufighter IIs was built as compared with 914 Beaufighter Is.

Further attention was given in 1940 to the Type 158, a slim-fuselage version of the Beaufighter that had been first proposed late in 1938. Two versions were proposed, the Beaufighter III with Hercules VI engines and the Beaufighter IV with Rolls-Royce Griffons, but neither version was in fact built. Another variant which failed to attain quantity production was the Beaufighter V. During its early service career the Beaufighter had evinced a tendency to nose down as a result of the recoil of the cannon. This was sufficient for the pilot to lose his target, and thought was given to alternative armament. The result was the Beaufighter V with one pair of cannon and the wing-mounted machine guns supplanted by a Boulton Paul turret containing four 0.303-in. machine guns and mounted just aft of the pilot's cockpit. Only two examples of this variant (R2274 and R2306) were produced, both being Mk.II conversions, and one of these was flown experimentally by No. 29 Squadron in April 1942. It was found, however, that the installation of the turret drastically reduced performance, and further development of the Beaufighter V was abandoned.



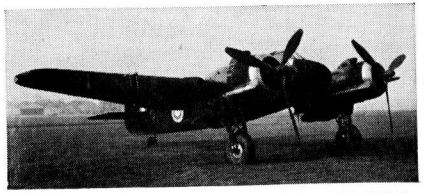
A Beaufighter II (R2375) prior to the introduction of a dihedral tailplane.



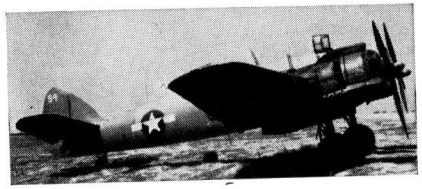
A Beaufighter II (R2274) fitted with a Boulton Paul turret as a prototype Beaufighter V.

The following specification relates to the Beaufighter IF.

Type: *Two-seat Night Fighter.* **Power Plants:** *Two* 1,590 *h.p. Bristol Hercules XI fourteen-cylinder air-cooled radial engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 240 *r.p.g. and six* 0.303-*in. Browning machine guns with* 1,000 *r.p.g.* **Performance:** *Maximum speed,* 323 *m.p.h. at* 15,000 *ft.; maximum cruising speed,* 272 *m.p.h. at* 15,000 *ft.; range,* 1,500 *mls. at* 194 *m.p.h.; initial climb rate,* 1,850 *ft./min.; service ceiling,* 28,900 *ft.* **Weights:** *Empty,* 14,069 *lb.; normal loaded,* 20,800 *lb.* **Dimensions:** *Span,* 57 *ft.* 10 *in.; length,* 41 *ft.* 4 *in.; height,* 15 *ft.* 10 *in.; wing area,* 503 *sq. ft.*



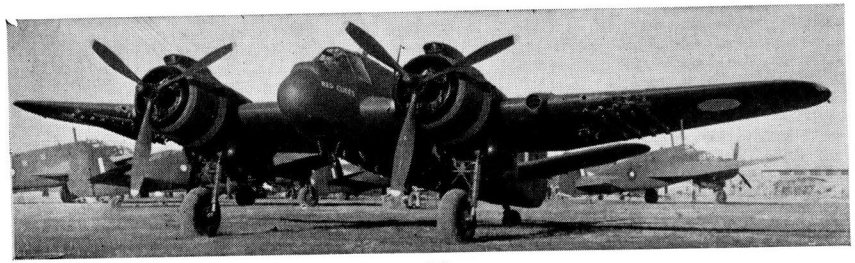
(Above) Beaufighter VIF night fighter (X7883) with A.I. radar in January 1942.

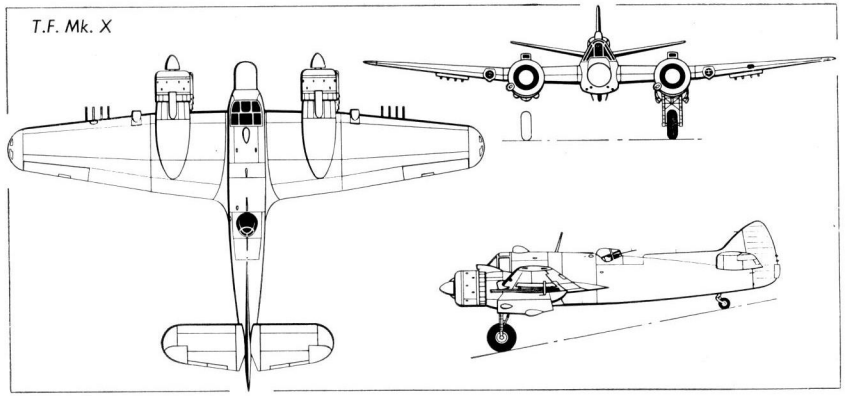


Early in 1941, production of the Bristol Hercules engine was mounting rapidly, and Hercules VI engines rated at 1,670 h.p. at 7,500 feet began to be available for Beaufighter installation. The more powerful engines were first tested in a Filton-built Beaufighter I (R2130) and in the third and fourth aircraft off the Weston-super-Mare production line (X7542 and X7543). With the Hercules VI engines and designated Beaufighter VI, the more powerful version supplanted the Mks. I and II in production late in 1941, and began to replace earlier models with both Fighter Command and Coastal Command at the beginning of 1942.

Powered by the Hercules VI or XVI, the Beaufighter VI was the first variant to be fitted with a 0.303-in. Vickers "K" gas-operated machine gun in the observer's station. A 50 Imp. gal. fuel tank could be fitted in the starboard wing gun bay and a 24 Imp. gal. tank in the port bay, and various armament combinations could be carried. Two 250-lb. bombs

(Above, left) A Beaufighter VIF of the U.S.A.F. 1st T.A.C., and (below) an R.A.A.F. Beaufighter Mk.21 The bulge ahead of the cockpit was intended to enclose the Sperry autopilot.

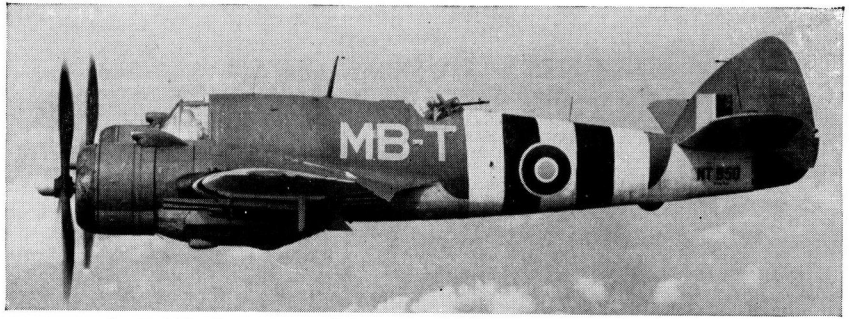




could be carried under the wings, or eight rocket missiles could be carried in lieu of the wing guns. In March 1942, work commenced on the adaptation of the Beaufighter VIC to carry a 22.5-in. American or 18-in. British torpedo. An experimental machine (X8065) flew in May 1942, proving the soundness of the scheme during torpedo-dropping trials at Gosport. Sixteen Beaufighter VICs were similarly converted to equip a trial squadron, No. 254, which achieved its first operational success against enemy shipping on April 4, 1943. Unofficially dubbed the "Torbeau", the torpedo-carrying Beaufighter VIC revolutionized air-sea warfare. In September 1942, a Beaufighter VIC (EL329) had been armed with rocket projectiles for the first time, and machines carrying this armament joined the squadrons in May 1943.

The Mk. VIF was the first version of the Beaufighter to be used by the R.A.F. in the India-Burma theatre, aircraft of this type entering service with No. 176 Squadron in the defence of Calcutta in January 1943. Beaufighter VIF fighters also equipped squadrons of the U.S.A.A.F. 1st Tactical Air Command, and total production of both VIC and VIF versions amounted to 1,830 machines.

The designation Beaufighter VII was applied to a variant which was to be fitted with Hercules VIII engines with turbo-superchargers and driving four-blade airscrews, but this was abandoned while still on the drawing board. Mark numbers VIII and IX were reserved for Australian-built Beaufighters but never allotted, and the next variant to see production was the Beaufighter T.F. Mk. X anti-shipping strike fighter. This was fitted with a modified version of the Hercules VI engine having cropped impellers and the super-

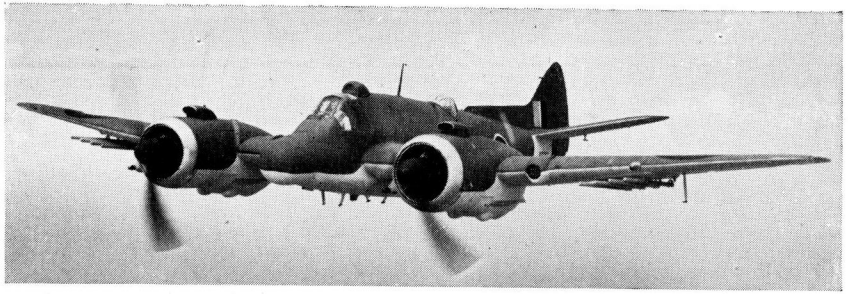


An R.A.F. Coastal Beaufighter X anti-shipping strike fighter.

chargers locked in "M" ratio, with fully automatic carburettors, and designated Hercules XVII, was well suited to the low altitudes at which Coastal Command operated its Beaufighters.

Intended specifically for R.A.F. Coastal Command, the Beaufighter T.F.Mk.X was equipped to carry a torpedo and was the first production variant to standardise on A.I. Mk. VIII radar in a "thimble" nose. The "thimble" nose (with either A.I.Mks. VII or VIII) had been fitted to some Beaufighter VIF night fighters—the last variant to serve with R.A.F. Fighter Command before the type was supplanted in the night-fighting role by the Mosquito—and had been found suitable for ASV use. Prior to the delivery of the first Mk.Xs, sixty Mk.VICs with Hercules XVI engines and provision or torpedo-carrying were built and delivered as the Beaufighter VI (I.T.F.)—interim torpedo fighter—being converted to Mk.Xs as more Hercules XVII engines became available. A total of 2,205 Beaufighter T.F.Xs was built (commencing JM268), the last aircraft of this type (SR919), and, incidentally, the last Beaufighter built in the United Kingdom, being completed on September 21, 1945. A similar aircraft was built without torpedo gear as the Beaufighter XIC for Coastal Command, 163 aircraft of this type being delivered, bringing total British production of Beaufighters of all types to 5,562 machines.

A further 364 Beaufighters were built in Australia for the R.A.A.F. Fifty-four Fairey-built Beaufighter ICs had been supplied to the R.A.A.F. during 1941-42, and plans prepared for the production of the type in Australia. The first proposal was to use Hercules XXVI engines with Bendix carburettors, and this version would have been otherwise similar to the Mk.VIC, but as a safeguard against possible delays in the delivery of adequate quantities of Hercules engines, one of the Fairey-built Beaufighter ICs (A19-2) was fitted experimentally with Wright Cyclone 14 GR-2600-A5B engines. The larger diameter of the Cyclones necessitated the enlarging and



A late-production Beaufighter X with A.I.Mk.VIII in thimble nose and dorsal fin extension.

lengthening of the nacelles, which were extended beyond the wing trailing edges. The Cyclone-powered Beaufighter was flown successfully, but by that time a final decision had been made in favour of the Hercules engine, and production commenced on a variant essentially similar to the Beaufighter T.F.X.

Designated Beaufighter Mk. 21, the first Australian-built machine (A8-1) was flown on May 26, 1944, and the 364th aircraft of this type was completed by the Mascot and Fishermen's Bend factories at the end of 1945. The Beaufighter Mk. 21's principal distinguishing feature was the bulge ahead of the cockpit for a Sperry autopilot, and although this was not usually installed the bulge was retained. Four 0.5-in. machine guns replaced the six 0.303-in. guns in the wings, and Hercules XVIII engines were installed—similar to the XVII but with both supercharger gears fully operational. The R.A.A.F.'s Beaufighter 21's wreaked great havoc among the Japanese along the coast of New Guinea, and in the Celebes and the Philippines, earning for themselves the grim nickname of "Whispering Death".

The following specification relates to the Beaufighter VIF, figures in parentheses relating specifically to the T.F.Mk.X.

Type: *Two-seat Night and Long-range (Anti-shipping Strike) Fighter.* **Power Plants:** *Two* 1,670 (1,770) *h.p. Bristol Hercules VI or XVI (XVII) fourteen-cylinder air-cooled radial engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 240 (283) *r.p.g. and six* 0.303-*in. Browning machine guns with* 1,000 *r.p.g. (one* 0.303-*in. Vickers "K" gun in dorsal position, one* 1,650-*lb. or* 2,127-*lb. torpedo, two* 250-*lb. bombs or eight* 90-*lb. rocket missiles).* **Performance:** *Maximum speed,* 333 (303) *m.p.h. at* 15,600 (1,300) *ft.; maximum cruising speed,* 276 (249) *m.p.h. at* 15,000 (5,000) *ft.; range,* 1,480 (1,470) *mls. at* 243 (205) *m.p.h. at* 15,000 (5,000) *ft., (with auxiliary fuel tanks in place of wing guns),* 1,810 *mls.; service ceiling,* 26,500 (15,000) *ft.* **Weights:** *Empty,* 14,600 (15,600) *lb.; maximum loaded,* 21,600 (25,200) *lb.* **Dimensions:** *Span,* 57 *ft.* 10 *in.; length,* 41 *ft.* 8 *in.; height,* 15 *ft.* 10 *in.; wing area,* 503 *sq.ft.*

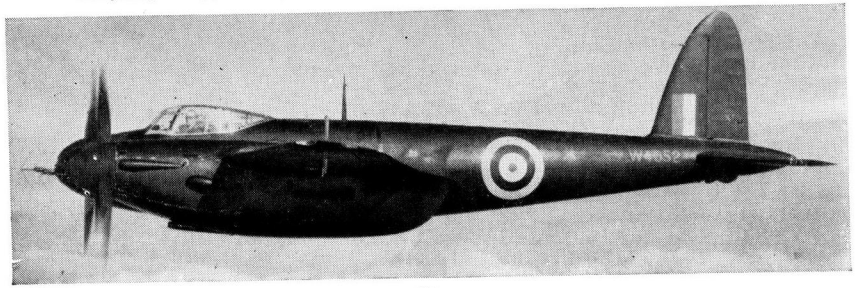
DE HAVILLAND MOSQUITO N.F.MKS.II, XII, XIII, XVII, XIX AND 30 GREAT BRITAIN

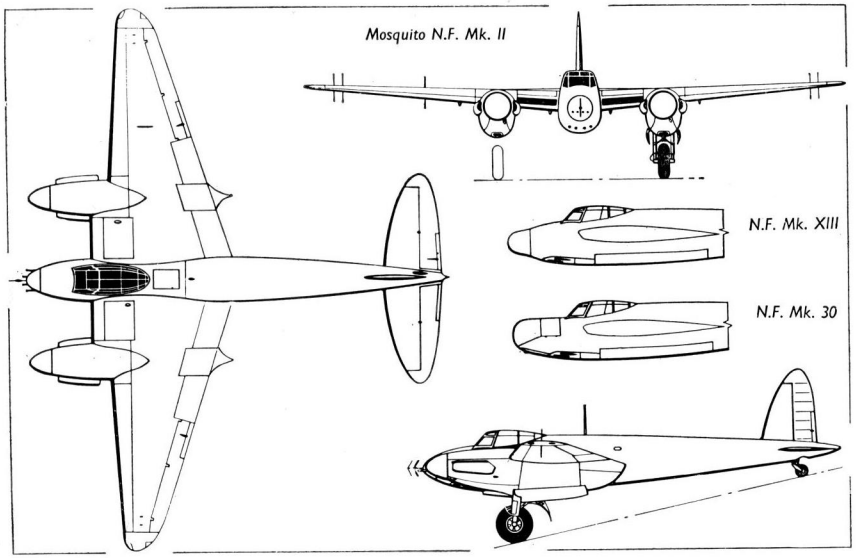
The de Havilland Mosquito was the most versatile military aircraft produced during World War II. It enjoyed unrivalled popularity in almost every Command and theatre of operations, and it excelled in all the widely varied roles for which it was found to be amenable but in none more so than that of night fighting. Conceived as a bomber, the Mosquito became the most potent of Allied night fighters.

The Mosquito was envisaged from the outset as a bomber to outperform existing fighters, and by the end of 1938, de Havilland's design studies had crystallized in the form of a twin-Merlin monoplane of wooden construction. On December 29, 1939, the Air Ministry accepted the company's proposal, which had been allocated the works designation D.H.98, and on March 1, 1940, a contract was placed for fifty D.H.98 bombers to specification B.1/40. It had earlier been pointed out to the Air Ministry that the design possessed considerable potentialities as a fighter and, despite lack of official interest, the manufacturer allowed for the installation of a quartette of 20-mm. cannon beneath the cockpit from the outset of detail design. This showed commendable foresight for, towards the end of 1940 as a result of some loss of confidence in the unarmed high-speed bomber concept, the original contract was changed to twenty bombers and thirty fighters.

The fighter variant was the second of three prototypes for which the name Mosquito had been approved, and with a bullet-proof windscreen, reinforced wing spars and a modified nose to take a heavy forward-firing armament, this aircraft (W4052) flew on May 15, 1941, conforming to specification F.21/40 and designated Mosquito II. It was later fitted with A.I. Mk. IV radar and was subsequently used for various experimental purposes, during the

The first prototype Mosquito II (W4052) after installation of the A.I.Mk. IV radar.



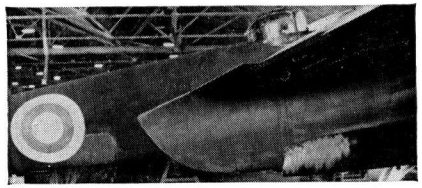


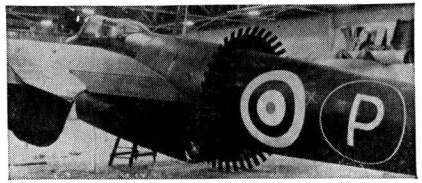
course of which it was at one time fitted with a Bristol B.XI four-gun dorsal turret immediately behind the cockpit, and at another with a bellows-operated segmented air brake fitted around the fuselage aft of the wing.

The Mosquito N.F.Mk.II night fighter which entered service with the R.A.F. Fighter Command in May 1942, the first deliveries being made to Nos. 23 and 157 Squadrons, was powered by either the Merlin 21 or 23, both of which engines gave the same maximum power of 1,460 h.p. at 6,250 ft., and carried an armament of four 20-mm. cannon in the front fuselage belly and four 0.303-in. machine guns in the extreme nose. Initially A.I.Mk.IV radar with its characteristic "arrowhead" antenna was installed, but this was later replaced by A.I.Mk.V. The matt black finish of the Mosquito N.F.Mk.II, incidentally, reduced maximum speed by 16 m.p.h.

Mosquito N.F.Mk.IIs were confined to home defence at the outset, scoring their first "probable" on the night of May 28-29, 1942, but No. 23 Squadron took its aircraft to Malta

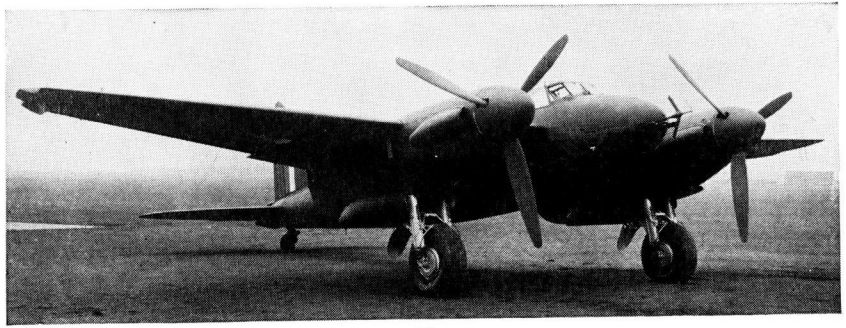
in December of that year, flying their first night intruder sortie from Luqa on the night of December 30-31, 1942. One Mosquito N.F.Mk.II was experimentally fitted with a 2,600-million-candlepower Helmore Turbinlite, while another (DD723) had chin radiators attached to its Merlin 23s in place of the standard wing leading-edge radiators. Of the 466 Mosquito II fighters produced (197 of these later being converted to N.F.Mks.XII and XVII), some of the later aircraft had day fighter finish and, with A.I. radar removed, operated over Malta, Italy, Sicily, and North Africa from 1943 onwards.





The Mosquito N.F.Mk.II was succeeded by the N.F.Mk.XII, the first British aircraft to carry centimetric A.I.Mk.VIII radar which introduced the spinning-dish scanner. To expedite the service introduction of the new radar, ninety-seven Mosquito N.F.Mk.IIs were converted to N.F.Mk.XIIs by the installation of the A.I.Mk.VIII which called for the deletion of the four nose-mounted Brownings. The first N.F.Mk.XII (DZ859) was flown in March 1943, and performance was

(Left) The prototype Mk.II fitted with B.XI dorsal turret and bellows-operated segmented air brakes, and (below) an early production Mk.II.



identical to that of the N.F.Mk.II apart from a very slight increase in take-off run resulting from an increase in maximum take-off weight from 18,800 lb. to 20,300 lb. Tare weight remained the same at 13,700 lb., but mean weight increased from 16,900 lb. to 18,700 lb. The next night fighting variant of the Mosquito, the N.F.Mk.XIII which appeared in February 1944, possessed generally similar characteristics to the Mk. XII apart from having underwing auxiliary tanks of 50 Imp. gal. capacity.

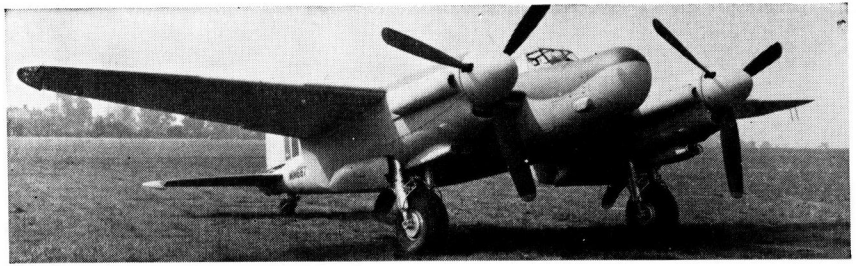
A total of 270 Mosquito N.F.Mk.XIIIs was built, but a proposed high-altitude version with Merlin 72 engines, the Mosquito N.F.Mk.XIV, was abandoned. A second high-altitude version which failed to attain service was the Mosquito N.F.Mk.XV. This had an interesting origin in 1942 when de Havilland were asked to produce at short notice a high-altitude Mosquito capable of intercepting the Junkers Ju 86P bomber which was then flying unmolested over Britain at altitudes above 40,000 feet. A Mosquito bomber prototype (MP469) fitted with high-rated Merlin 60 Series engines, a pressure cabin, increased wing span and smaller wheels, had some tankage and armour removed and four machine guns fitted in the nose as an experimental high-altitude fighter. The conversion took seven days, and the aircraft attained an altitude of 43,500 feet. This experimental aircraft served as the basis for the Mosquito N.F.Mk.XV high-altitude night fighter, five examples of which were produced by the conversion of B.Mk.IV airframes. Merlin 77 engines were installed, A.I.Mk.VIII radar was fitted in the nose, and the machine guns were moved to a blister under the fuselage. Little subsequent demand arose for a night fighter with such high-altitude capabilities, however, and no further conversions were made.

Soon after production of the Mosquito N.F.Mks.XII and XIII was initiated, American

A Mosquito N.F.XII (HK117) in March 1943

centimetric radar became available to supplement British production. Known as SCR720 and 729, and designated A.I.Mk.X in Britain, the American radar was mounted in one hundred Mosquito N.F.Mk.IIs which then became known as N.F.Mk.XVIIs, while the Mosquito N.F.Mk.XIX was placed in production as the equivalent of the N.F.Mk.XIII but carrying A.I.Mk.X. A total of 220 Mosquito N.F.Mk.XIXs was built, the first of these (DZ857) flying in May 1944. Most N.F.Mk. XIXs were fitted with the up-rated Merlin 25s, and maximum loaded weight rose to 21,500 lb.

The last night fighting variant to see operational service during World War II was the Mosquito N.F.Mk.30 which, intended to replace the N.F.Mk.XIX and equipped with similar A.I.Mk.X radar, differed from its predecessors in having a higher-altitude ability derived from the use of the Merlin 72 in the first seventy production aircraft and the Merlin 76 in subsequent machines. The Mosquito N.F.Mk.30 was introduced late in 1944, and apart from serving with home-defence squadrons, it was operational from bases on the Continent. It also supplanted the Mosquito F.B.Mk.VIs employed by No. 100 Group to accompany the heavy bomber streams over Germany and provide a measure of protection from Luftwaffe night fighters. Six squadrons of



*The last night-fighting variant to see operational service, the N.F.Mk.*30 (*MM*687).

N.F.Mk.30s were operating with No. 100 Group and seven squadrons with R.A.F. Fighter Command by May 1945, but scheduled production of between 800 and 900 night fighters of this type was cut back to between 300 and 400 machines with the end of the war.

The final wartime development of the Mosquito night fighter, the N.F.Mk.36, was essentially similar to the N.F.Mk.30 but standardised on Merlin 113 engines, and the first machine of this type (RK955) was flown in May 1945. The N.F.Mk.38, which differed in having British A.I.Mk.IX radar in place of the American A.I.Mk.X, was purely a post-war development.

The first of the following specifications relates to the Mosquito N.F.Mk.XIII, the performance quoted being equally applicable to the N.F.Mks.II and XII, figures quoted in parentheses relating to the N.F.Mk.XIX. The second specification relates to the N.F.Mk.30.

Type: *Two-seat Night Fighter and Intruder.* **Power Plants:** *Two* 1,460 (1,635) *h.p. Rolls-Royce Merlin* 23 (25) *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 150 *r.p.g.* **Performance:** *Maximum speed,* 356 (358) *m.p.h. at* 9,000 (5,500) *ft.,* 370 (372) *m.p.h. at* 14,000 (13,000) *ft.; maximum cruising speed,* 328 (325) *m.p.h. at* 15,000 *ft.; range,* 1,520 (1,500) *mls. at* 255 *m.p.h. at* 15,000 *ft., (with two* 50 *Imp. gal. drop tanks)* 1,860 (1,830) *mls.; time to* 15,000 *ft.,* 6.75 *min.; service ceiling,* 34,500 *ft.* **Weights:** *Empty,* 14,300 (14,000) *lb.; normal loaded,* 18,100 (19,600) *lb.; maximum,* 20,000 (21,500) *lb.* **Dimensions:** *Span,* 54 *ft.* 2 *in.; length,* 40 *ft.* 10¾ in.*; height,* 15 *ft.* 3½ *in.; wing area,* 454 *sq.ft.*

Type: *Two-seat Night Fighter and Intruder.* **Power Plants:** *Two* 1,710 *h.p. Rolls-Royce Merlin* 76 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 150 *r.p.g.* **Performance:** *Maximum speed,* 385 *m.p.h. at* 15,000 *ft.,* 407 *m.p.h. at* 28,000 *ft.; maximum cruising speed,* 317 *m.p.h. at* 15,000 *ft.; range,* 1,300 *mls. at* 250 *m.p.h. at* 15,000 *ft., (maximum auxiliary fuel)* 1,770 *mls.; time to* 15,000 *ft.,* 7.5 *min.; service ceiling,* 39,000 *ft.* **Weights:** *Empty,* 15,400 *lb.; normal loaded,* 20,000 *lb.; maximum,* 21,000 *lb.* **Dimensions:** *Span,* 54 *ft.* 2 *in.; length,* 40 *ft.* 10¾ *in.; height,* 15 *ft.* 3½ *in.; wing area,* 454 *sq.ft.*

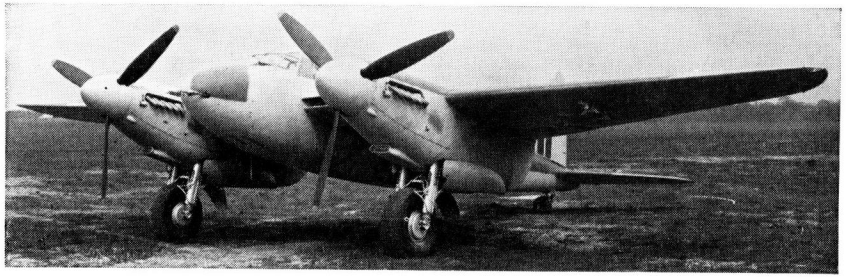
DE HAVILLAND MOSQUITO F.B.MKS.VI AND XVIII

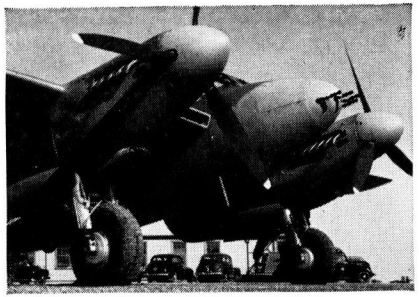
GREAT BRITAIN

Experience with the Mosquito N.F.II fighter led, in 1943, to the development of a fighter-bomber version, the Mosquito F.B.Mk.VI, destined to become the most widely used of all Mosquitos and to be produced in larger quantities than any variant of this remarkable warplane. It had been discovered that the Mosquito was capable of accommodating a much larger warload than that originally envisaged. Thus, the B.Mk.IV with a strengthened wing for external loads which later became known as the "basic" wing, was fitted with a full complement of cannon and machine guns, the forward half of the bomb-bay containing the cannon breeches and the aft portion accommodating a pair of 500-lb. bombs. Wing racks were provided for an additional pair of 500-lb. bombs or two 50 Imp. gal. fuel tanks. Actually, the full 2,000-lb. bomb load was only carried by the F.B.Mk.VI Series 2 which took advantage of the 1,635 h.p. available from the Merlin 25, the first 300 machines being F.B. Mk.VI Series 1 Mosquitos with 1,460 h.p. Merlin 21s or 23s, and carrying two 250-lb. bombs internally.

The prototype F.B.Mk.VI was actually a converted Mosquito II (HJ662) which flew for the first time in February 1943, and within three months the new variant had entered service with No. 418 Squadron. Nearly 2,600 F.B.Mk.VI Mosquitos were subsequently produced in the United Kingdom (1,218 by de Havilland, 1,066 by Standard Motors and 300 by Airspeed), and the variant remained in service until the end of the war, being used as a day and night intruder by the 2nd T.A.F. in Europe as well as by R.A.F. Fighter Command. It saw service in the Far East where it made its operational début at the beginning of 1944, succeeding the Blenheim V in attacking Japanese supply lines and strong points in Burma. The Mosquito F.B.Mk.VI also

*An early Mosquito F.B.VI Series 1 (HJ*719). *The type entered service with No.* 418 *Sqdn. in May* 1943.





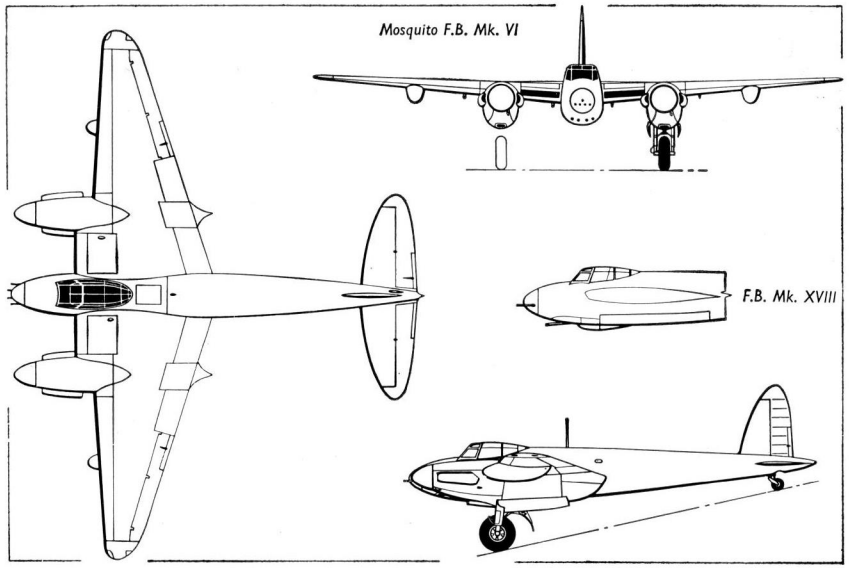
A Canadian-built Mosquito F.B.26.

entered service with R.A.F. Coastal Command early in 1944 for anti-shipping strikes, usually carrying eight 60-lb. rocket missiles in lieu of bombs under the wings, but prior to this, a version specially evolved for Coastal Command, the Mosquito F.B.Mk.XVIII—sometimes known as the "Tse-tse"—had joined operations.

The prototype Mosquito F.B.Mk.XVIII, a converted F.B.Mk.VI (HJ732), had flown for the first time on August 25, 1943, and a 57-mm. Molins gun supplanted the four 20-mm. cannon in the nose. In addition to the Molins gun and the usual quartette of Brownings, this variant carried two 500-lb. bombs or eight rocket missiles under the wings. It proved particularly efficacious against shipping, submarines and shore installations, first going into action on November 4, 1943. On March 25, 1944, a Mosquito F.B.Mk.XVIII sank a U-boat, but only twenty-seven examples of this variant were produced.

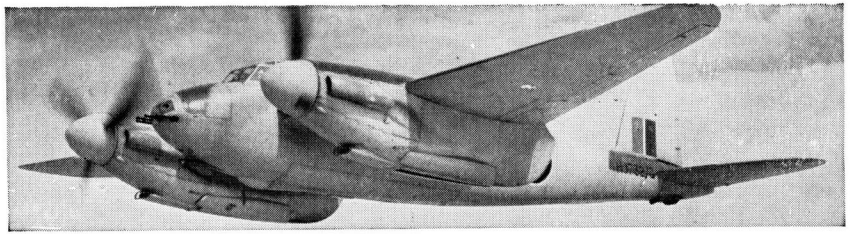
In September 1941, two de Havilland engineers had arrived in Canada to establish a Mosquito production line at the company's Toronto plant, and the first Canadian-built Mosquito (a B.Mk.VII, KB300) flew almost exactly a year later, in September 1942. It was the forerunner of 1,032 Mosquitos turned out in Canada before the end of the war. While the Mosquito B.Mk.IV was selected as the basic aeroplane for Canadian production, one of the principal variants built at Toronto was the F.B.Mk.26 which was based upon the F.B.Mk.VI and carried the same armament as its British counterpart but had Packard Merlin 225 engines. Three hundred and thirty-eight Mosquito F.B.Mk.26s (KA103-440 inclusive) were built, the original contracts which called for 670 machines being cut back at the end of the war. The F.B.Mk.26 was preceded by the F.B.Mk.21 with Packard Merlin 31 or 33 engines, only three examples of which were built (KA100-102 inclusive), and one F.B.Mk. 24 (KA928) high-altitude fighter-bomber with two-stage supercharged Packard Merlin 69s.

Australia too became a source of Mosquitos with the establishment of a production line at de Havilland's Sydney plant. The first drawings arrived in Australia in June 1942, followed by an example of the Mosquito II (A52-1001). No production of the pure bomber version was undertaken in Australia, the first Australian-built variant being the F.B.Mk.40 (commencing A52-1) of which 178 examples were eventually built, the first 100 having Packard Merlin 31s and subsequent machines having Packard Merlin 33s. The F.B.Mk.40 was essentially similar to the F.B.Mk.VI, and the first machine was flown on July 23, 1943. A production F.B.Mk.40 (A52-90) was fitted with two-stage supercharged Packard Merlin 69s as the prototype F.B.Mk.42, but this project was abandoned after initial flight trials, and the aircraft was subsequently employed as the prototype Mosquito P.R.Mk.41, a new serial number (A52-300) being allocated to the



machine. When the Pacific War ended, 108 Mosquitos had been built in Australia (although a further 104 Mosquitos were produced after the war), and in addition to these, the R.A.A.F. received twelve Mosquito F.B.Mk. VIs from the United Kingdom (A52-500 to 511 inclusive), the first of these arriving early in 1945.

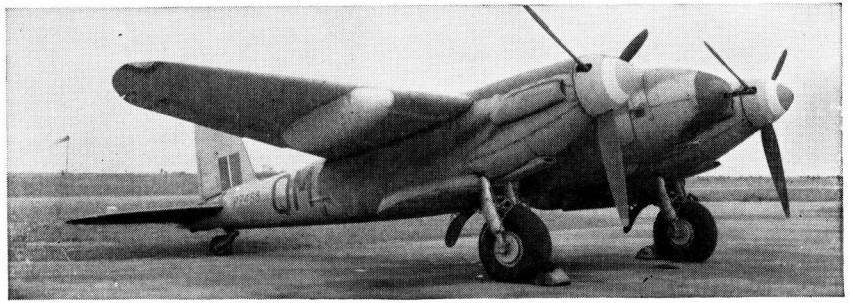
Early in 1944, a Mosquito F.B.Mk.VI was fitted with improvised arrester gear with which it commenced deck-landing trials aboard H.M.S. *Indefatigable*, becoming the first British twin-engined aircraft to land aboard a carrier on March 25, 1944. The success of initial trials resulted in a second F.B.Mk.VI (LR387) being fully navalised with folding wings and a thimble-type nose radome to specification N.15/44. This served as a prototype for the post-war Sea Mosquito T.R.Mk.33 torpedo-reconnaissance aircraft, the first example of which (TW227) flew on November 10, 1945.



(*Above*) *Trial installation of a Molins gun in a Mosquito F.B.VI* (*HJ*732) *and* (*below*) *one of the twenty-seven production F.B.Mk.XVIIIs.*

The following specification relates to the Mosquito F.B.Mk.VI Series 2.

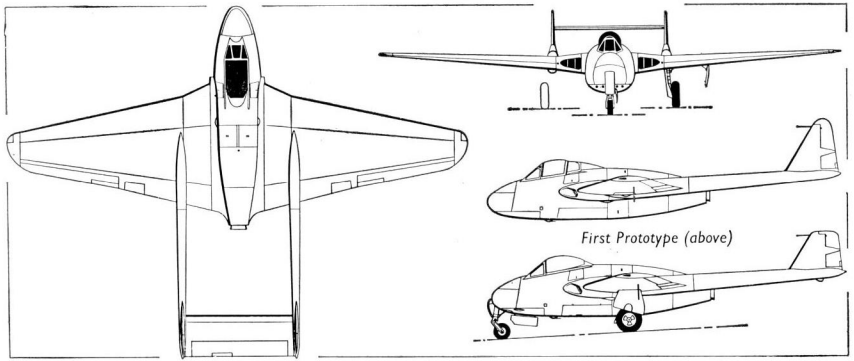
Type: *Two-seat Fighter-bomber.* **Power Plants:** *Two* 1,635 *h.p. Rolls-Royce Merlin* 25 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 150 *r.p.g. and four* 0.303-*in. Browning machine guns with* 500 *r.p.g., plus* 2,000 *lb. bombs or* 1,000 *bombs and eight* 60-*lb. rocket missiles.* **Performance:** *Maximum speed,* 362 *m.p.h. at* 5,500 *ft.,* 380 *m.p.h. at* 13,000 *ft.; maximum cruising speed,* 325 *m.p.h. at* 15,000 *ft.; range,* 1,270 *mls.,* (*with wing bombs only*) 1,400 *mls.,* (*with fuselage bombs only*) 1,650 *mls.; initial climb rate,* 1,870 *ft./min.; time to* 15,000 *ft.,* 9.5 *min.; service ceiling,* 33,000 *ft.* **Weights:** *Empty,* 14,300 *lb.; normal loaded,* 19,500 *lb.; maximum,* 22,300 *lb.* **Dimensions:** *Span,* 54 *ft.* 2 *in.; length,* 40 *ft.* 10¾ *in.; height,* 15 *ft.* 3½ *in.; wing area,* 454 *sq. ft.*

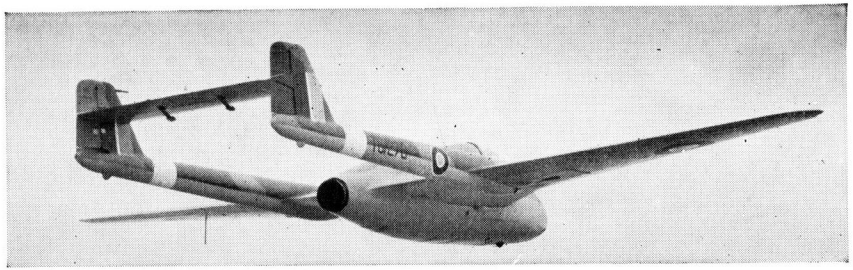


DE HAVILLAND VAMPIRE — GREAT BRITAIN

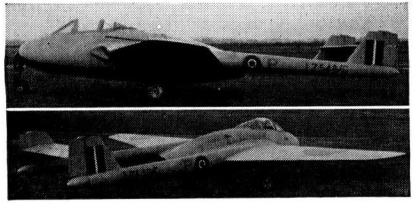
In the design of Britain's second jet fighter, the D.H.100 Vampire, de Havilland's team adopted a novel approach to the problem of keeping intake ducting and tailpipe lengths to a minimum in order to avoid undue friction losses. The use of externally mounted turbojets as envisaged for the Gloster jet fighter then being developed to the requirements of specification F.9/40 did not appeal to de Havilland's team as it demanded two powerplants, while the straight-through flow arrangement of the experimental Gloster E.28/39 had the serious disadvantage of restricting internal space. To avoid the disadvantages of both layouts, the D.H.100 designed to the requirements of specification E.6/41 employed a single turbojet installed in the rear of a short central fuselage nacelle, drawing air from wingroot intakes and exhausting between twin tailbooms. Unbeknown to de Havilland, the German Focke-Wulf design team headed by Hans Multhopp had reached identical conclusions, and the *Projekt VII* "Flitzer" jet fighter which, in the event, was abandoned in 1943 in favour of more advanced projects, bore a remarkable resemblance to the finalised D.H.100 design.

Initially known as the "Spider Crab", the first prototype of the D.H.100 (LZ548) flew for the first time on September 26, 1943, powered by a 2,700 lb.s.t. Halford H-1 (Goblin) turbojet. Second and third prototypes (MP838 and LZ551) followed, these differing externally from the first machine in having squared-off vertical tail surfaces which supplanted the tall, pointed surfaces with which LZ548 was first flown. Officially named Vampire, the new fighter was ordered into





(*Above*) *The fourth production Vampire I* (*TG*278) *and* (*below, left*) *the first Vampire prototype* (*LZ*584) *with later vertical tail surfaces.*



production at the English Electric Company's Preston plant, the initial contract for 120 Vampire Is being placed on May 13, 1944. A year later, on May 7, 1945, a further 180 machines were ordered, and the first production Vampire I (TG274) flew on April 20, 1945 at Samlesbury.

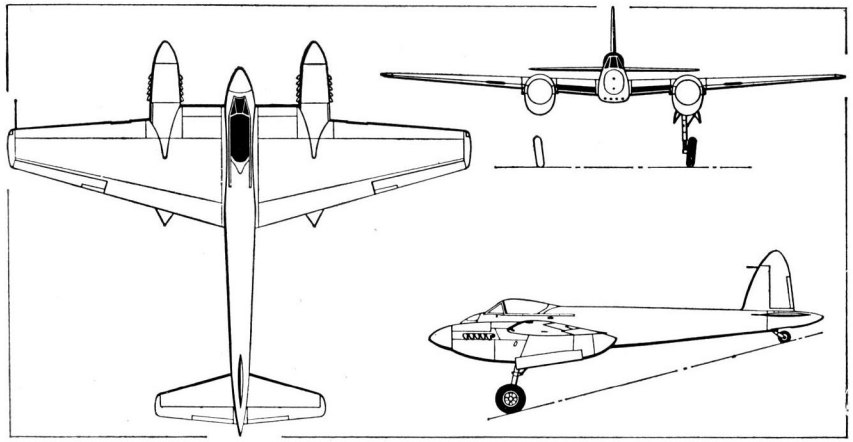
The first forty Vampire Is were fitted with similar engines to that of the first prototype, but the forty-first and subsequent Vampire Is received the 3,100 lb.s.t. Goblin II. The first fifty Vampire Is were unpressurised, but a pressure cabin was introduced on the fifty-first production aeroplane which also featured an increase in internal fuel capacity from 202 to 326 Imp. gal. and airship-type wing tanks. These auxiliary tanks were first tested on the first production Vampire I (TG274), and as the war ended, the third prototype (LZ551) was being converted to undertake trials aboard H.M.S. *Ocean*, eventually becoming the first pure jet aircraft to operate from a carrier deck on December 3, 1945. The first squadron to receive the Vampire I, No. 247, did not take delivery of its aircraft until after the termination of hostilities.

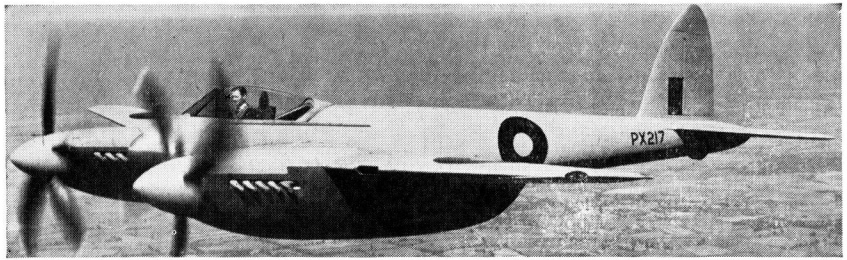
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 3,100 *lb.s.t. de Havilland Goblin II centrifugal compressor turbojet.* **Armament:** *Four* 20-*mm. Hispano cannon with* 150 *r.p.g.* **Performance:** *Maximum speed,* 531 *m.p.h. at* 17,500 *ft.*; *range,* 730 *mls. at* 380 *m.p.h. at* 30,000 *ft.*, (*with two* 100 *Imp. gal. drop tanks*) 1,145 *mls.*; *initial climb rate,* 4,200 *ft./min.* **Weights:** *Empty,* 6,372 *lb.*; *normal loaded,* 8,578 *lb.*; *maximum,* 10,480 *lb.* **Dimensions:** *Span,* 40 *ft.* 0 *in.*; *length,* 30 *ft.* 9 *in.*; *height,* 8 *ft.* 10 *in.*; *wing area,* 266 *sq. ft.*

DE HAVILLAND HORNET — GREAT BRITAIN

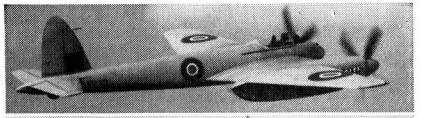
The de Havilland D.H.103 Hornet was perhaps the most graceful twin-engined monoplane to be produced by any of the combatants during World War II. The experience gained by the company with the Mosquito, coupled with a need for a long-range single-seat fighter for use in what appeared likely to be a prolonged island-hopping campaign in the South Pacific against the Japanese, led to the design of an unusually clean Merlin-powered aircraft to specification F.12/43. Two alternative projects, the D.H.101 and D.H.102, were abandoned in favour of the D.H.103, design work on which was initiated prior to the issue of the official specification which was largely framed around de Havilland's preliminary design studies for a twin-engined fighter.

The first prototype D.H.103 (RR915), officially to be named Hornet, was flown on July 28, 1944, and the second prototype (RR919) differed solely in having an armament of four 20-mm. cannon, the first machine having been unarmed. The second prototype was used for operational trials and, later, with underwing stores. Production of sixty Hornet F.Is (PX210-253 and PX273-288) was commenced late in 1944, and the first aircraft off the line flew on February 1, 1945. The prototypes of the Hornet had achieved the phenomenal speed of 485 m.p.h., and with full operational equipment the production Hornet F.I was only a shade slower at 472 m.p.h. The Hornet





(Above) The 8th production Hornet F.1, (below, left) the second Hornet prototype and (bottom, left) the first prototype.



was too late to see operational service, however, the first squadron, No. 64, re-equipping early in 1946.

The seventh production Hornet F.I (PX216) was fitted with an additional fuselage tank, increased wing tankage, and one K17, one F45 and two F52 cameras as the first prototype Hornet P.R.II which appeared in November 1945. Two more Hornet F.Is were converted as prototype P.R.Mk.IIs (PX220 and PX249), and these were followed by five production machines, but the photo-reconnaissance requirement terminated with the end of the war. Another conversion of a Hornet F.I initiated before the end of the war was the navalisation of two machines (PX212 and 214) to specification N.5/44 as prototypes of the Sea Hornet. The first of these conversions flew on April 19, 1945. A third navalised conversion (PX219) was equipped with folding wings by Heston Aircraft, this flying shortly after the termination of hostilities.

Type: *Single-seat Long-range Fighter and Fighter-bomber.* **Power Plants:** *Two* 2,030 *h.p. Rolls-Royce Merlin* 130/131 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano cannon and two* 1,000-*lb. bombs or eight* 60-*lb. rocket projectiles.* **Performance:** *Maximum speed,* 472 *m.p.h. at* 22,000 *ft.,* 438 *m.p.h. at* 10,000 *ft.; range (with two* 100 *Imp. gal. drop tanks),* 1,500 *mls.; maximum climb rate,* 4,000 *ft./min.; service ceiling,* 37,500 *ft.* **Weights:** *Empty,* 12,820 *lb.; maximum loaded,* 17,700 *lb.* **Dimensions:** *Span,* 45 *ft.* 0 *in.; length,* 36 *ft.* 8 *in.; height,* 14 *ft.* 2 *in.; wing area,* 361 *sq. ft.*

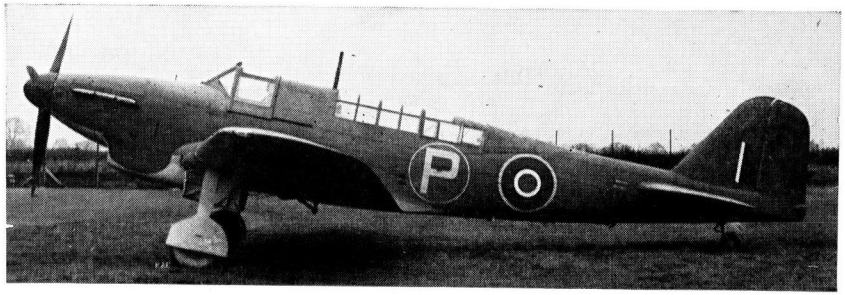
FAIREY FULMAR

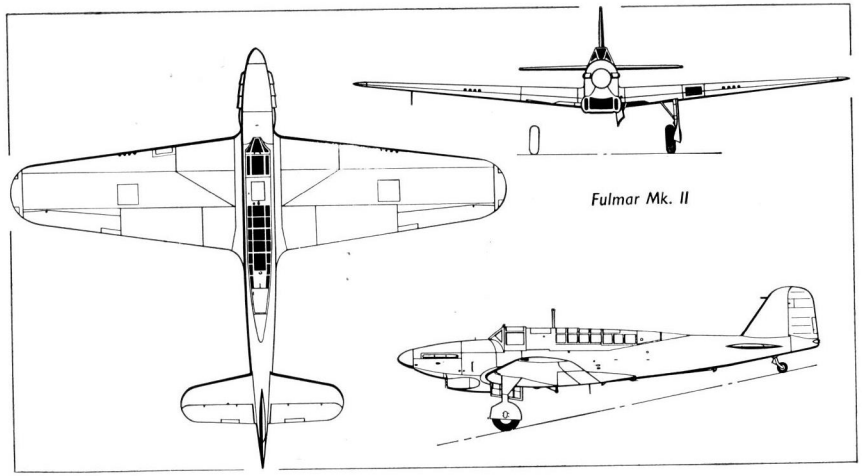
GREAT BRITAIN

The first eight-gun fighter to enter service with the Fleet Air Arm, the Fulmar two-seat shipboard general-purpose fighter was designed at a time when the Admiralty held the view that navigational aids were inadequate to ensure the safe return of a single-seat fighter to its carrier in inclement weather, and that a navigator was, therefore, indispensable. Following an urgent admiralty request late in 1937 for a folding-wing fighter with the same firepower as the R.A.F.'s Hurricane and Spitfire but providing accommodation for a navigator and all the radio equipment considered essential for fleet work, Marcelle Lobelle and his design team decided to evolve such a machine from a high-performance two-seat light bomber developed some three years earlier to meet the requirements of specification P.4/34. The result, the Fulmar, was an excellent aeroplane; manoeuvrable with fine low-speed characteristics and a respectable endurance, but like all shipboard aircraft of its time, it lacked the speed of its land-based contemporaries.

Specification P.4/34 had been issued on November 12, 1934, and to fulfil its requirements the Fairey company produced what was virtually a refined, lightweight version of the Battle. Two prototypes were built, the first (K5099) flying on January 13, 1937 with a Merlin F.15 engine, and the second (K7555) following on April 19, 1937 with a Merlin F.19. The admiralty drew up specification O.8/38 around a shipboard fighter variant of the basic Fairey bomber design. Externally, the fighter, which was to receive the name Fulmar, differed little from its predecessor, but further reductions in weight were effected, deck arrester gear, catapult points, wing-folding and naval equipment were incorporated, and a wing-mounted battery of eight 0.303-in. guns was provided.

The first Fulmar I (N1854) which flew for the first time on January 4, 1940.





The first Fulmar prototype (N1854), which flew for the first time on January 4, 1940, was actually the first aircraft off the production line, and was followed by a second machine (N1855) on April 6, 1940, this reaching the A. & A.E.E. at Boscombe Down for official trials on May 3rd. The first Production Trials Aircraft (N1856) was delivered to the Service Trials Unit at Lee-on-Solent on May 10th, and a further eleven machines had been completed by June 17th. The rapidity with which the Fulmar was introduced into service was as spectacular as the speed with which the fighter achieved full production status. No. 806 Squadron re-formed with twelve Fulmars in July 1940, arriving in the Mediterranean aboard H.M.S. *Illustrious* in August, and joining combat with aircraft of the Regia Aeronautica during the following month when protecting Malta-bound convoys. Two more squadrons, Nos. 807 and 808, had re-formed with the Fulmar by the end of 1940; five more squadrons became operational on the Fulmar in 1941, and a further six in 1942.

Fulmars saw extensive action in the Mediterranean where, initially, their low maximum speed placed them at no great disadvantage owing to the relatively low performances of the Regia Aeronautica aircraft by which they were opposed. In March 1941, No. 805 Squadron's Fulmars fought in the defence of Crete, and in the following August, a Fulmar became one of the first fighters to be catapulted from an armed merchantman—the

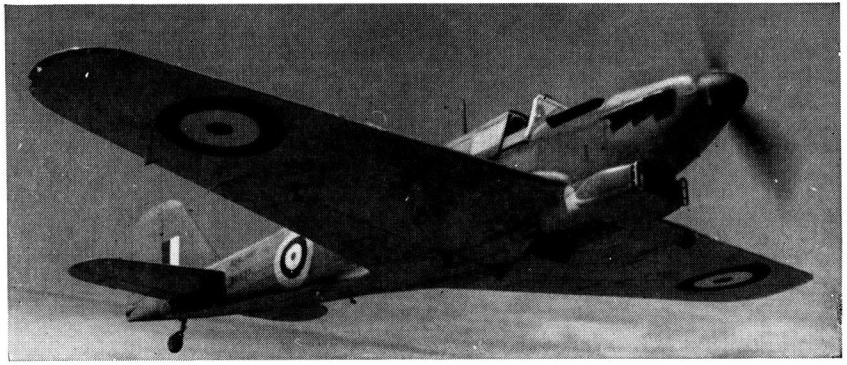
Afriquani—on convoy duties across the Atlantic. Fulmars were also active in the night-intrusion role, operating from May to November from Malta with No. 800X Squadron.

Two hundred and fifty Fulmar Is (commencing N1856) powered by the 1,080 h.p. Merlin VIII were produced for the Fleet Air Arm, and in an attempt to improve performance, one of these (N4021) was fitted with a 1,300 h.p. Merlin 30 with which it flew on January 30, 1941, becoming the prototype Fulmar II. The Fulmar II had the more powerful engine and tropical equipment, and 350 were built (commencing X8525), production being completed with DR749 in February 1943. Increasingly handicapped by its low speed, the Fulmar was progressively replaced by single-seat fighters from 1942, although a flight of Fulmar II night fighters operated by No. 813 Squadron accompanied several convoys to Russia during the winter of 1944–45.

The following specification relates to the Fulmar II.

Type: *Two-seat Shipboard General-purpose Fighter and Fighter-bomber.* **Power Plant:** *One* 1,300 *h.p. Rolls-Royce Merlin* 30 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Eight* 0.303-*in. Browning machine guns with* 500 *r.p.g.* (*some fitted with single hand-operated* 0.303-*in. Vickers "K" gun in rear cockpit*) *plus two* 100-*lb. or* 250-*lb. bombs.* **Performance:** *Maximum speed,* 265 *m.p.h. at* 1,750 *ft.,* 272 *m.p.h. at* 7,250 *ft.; maximum cruising speed,* 230 *m.p.h. at* 5,000 *ft.; economical cruising speed,* 196 *m.p.h.; range,* 780 *mls.; initial climb rate,* 1,320 *ft./min.; time to* 5,000 *ft.,* 4.4 *min.; serv ce ceiling,* 27,200 *ft.* **Weights:** *Normal loaded,* 9,672 *lb.; maximum,* 10,200 *lb.* **Dimensions:** *Span,* 46 *ft.* 4½ *in.; length,* 40 *ft.* 2 *in.; height,* 10 *ft.* 8 *in.; wing area,* 342 *sq. ft.*

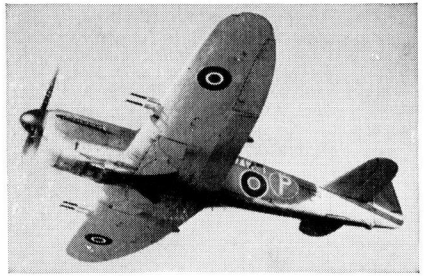
A late-production Fulmar II (DR673). Three hundred and fifty of this version were built.



FAIREY FIREFLY

GREAT BRITAIN

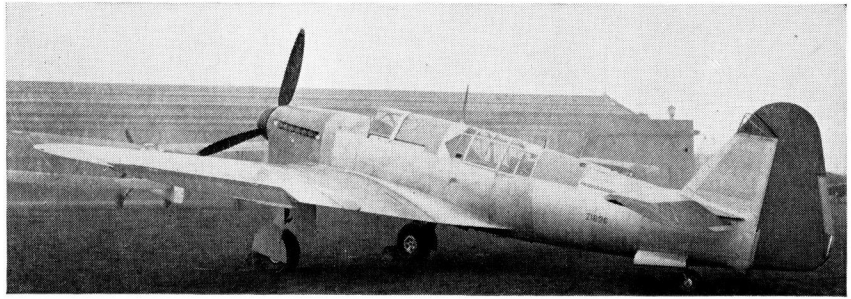
The Firefly brought versatility to a degree previously unapproached in a carrier-borne aircraft. Despite the fact that its wartime career was relatively brief, the Firefly not seeing action until mid-July 1944, it fought in practically every operational theatre, from the Arctic to the Tropics, emerging as perhaps the most successful of British wartime shipboard aeroplanes.

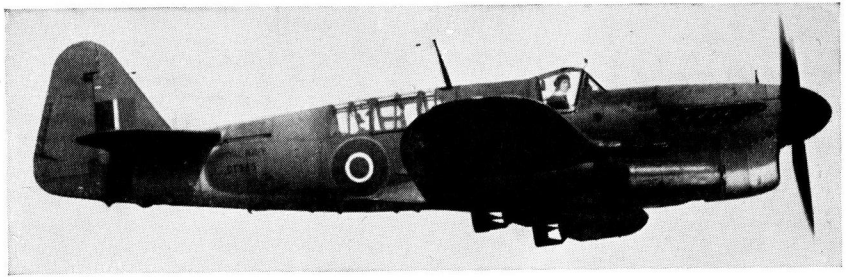


The admiralty formulated new requirements for shipboard fighters in 1939, issuing specifications N.8/39 and N.9/39 which respectively called for a fixed-gun fighter and a fighter possessing a power-driven turret in which all armament was concentrated. The Fairey design team, headed by H. E. Chaplin, submitted project tenders to both specifications, but concluded that a clean two-seat fighter with a fixed-gun armament offered greater potentialities. A design on these lines was then submitted to the admiralty, accepted in principle, and on June 6, 1940, ordered to the revised specification N.5/40, the initial contract calling for 200 machines. The specified armament of four 20-mm. cannon was, at that time, the heaviest ever envisaged for a shipboard fighter, and the Rolls-Royce Griffon engine upon which the design was based was then a completely untried power plant.

On November 16, 1940 the first drawing was

(Left and below) The first prototype Firefly (Z1826) which flew on December 22, 1941.

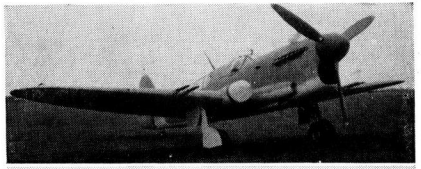


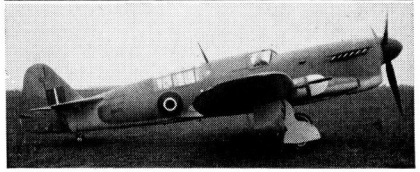


(Above) A Firefly F.R.Mk.I and (below, right) the Firefly N.F.Mk.II with wing radomes.

issued to the experimental shop, production planning commencing simultaneously, and during the following month the name Firefly was selected for the design. A yearlater, on December 22, 1941. the first prototype (Z1826) made its initial flight, and barely fourteen months were to elapse between this event and the acceptance of the first production Firefly (Z1830) on March 4, 1943. Three further prototypes were completed (Z1827-1829), these flying in March, August and September 1942, and by the time quantity deliveries of the Firefly F.I began, production contracts totalled 800 aircraft, comprising 500 Mk.Is, 200 Mk.IIs and 100 Mk.IIIs.

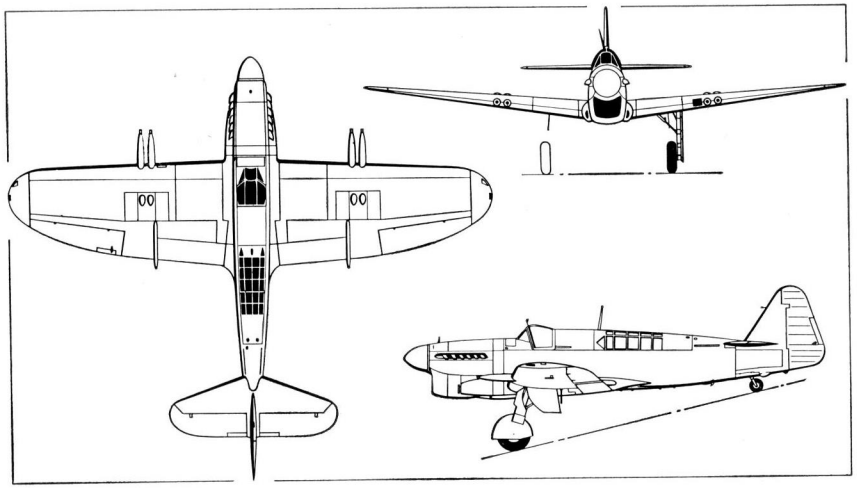
The first operational unit to receive the Firefly F.I was formed at Yeovilton on October 1, 1943. This squadron, No. 1770, eventually embarked aboard H.M.S. *Indefatigable*, making its operational début in Norwegian waters in July 1944 during attacks on the *Tirpitz*. The second Firefly squadron, No. 1771, made its first operational sorties in October 1944, but the first major naval action in which the Firefly F.I participated took place in January





1945 with an attack against the Japanese in Sumatra.

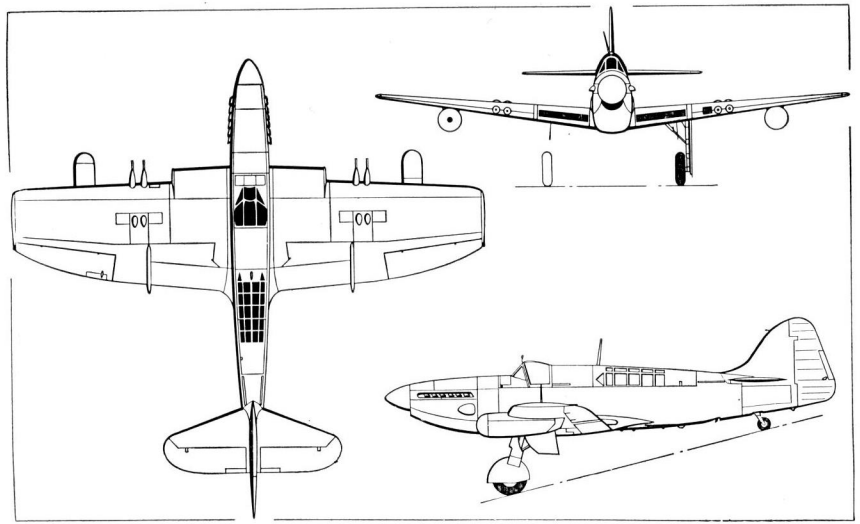
The parent company built 297 Firefly F.Is, a further 132 machines of this type being produced under sub-contract by General Aircraft. At an early stage in production the

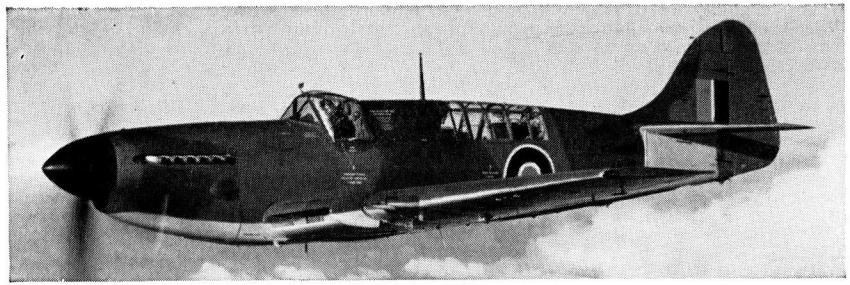


pilot's cockpit canopy was increased in height, and fairings were added to the wing-mounted cannon. The second production aircraft (Z1831) was modified as the prototype Firefly N.F.II, a complementary type carrying A.I. radar, the scanners for which were housed in two small radomes attached to the wing leading edges inboard of the cannon. In order to compensate for the additional equipment installed in the rear cockpit, an additional 15-in. bay was inserted between the forward cockpit and the firewall. Thirty-seven production N.F.Mk.IIs followed at intervals along the production line, but the development of more compact radar made it possible to adapt the basic Mk.I airframe for the night-fighting role, a radar pod being slung beneath the fuselage nose and the exhausts shrouded to form the Firefly N.F.I. This superseded the N.F.Mk.II, all examples of which were converted back to Mk.I standards.

The Firefly F.I was succeeded by the F.R.Mk.I fighter-reconnaissance aircraft carrying ASH shipping detection radar. Some Firefly F.Is were brought up to F.R.Mk.I standards as F.Mk.IAs. All production Fireflies prior to the 471st machine were powered by the 1,730 h.p. Griffon IIB, but subsequent Mk.I aircraft received the 1,765 h.p. Griffon XII. A total of 376 F.R.Mk.Is was produced, the last of these (TW679) being completed on November 23, 1946.

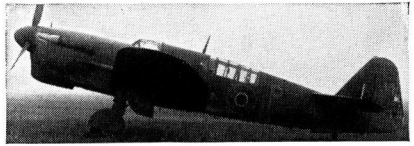
The availability of the first two-stage Griffon 61 Series engines resulted in the installation of one of these in an early production Firefly F.I (Z1835) as the prototype Firefly III. A bulbous, crescent-shaped chin radiator was used but the installation was not entirely satisfactory aerodynamically, and it was decided that, in order to make the best possible use of the increased power available, a more extensive redesign was necessary. Thus, the Firefly III was abandoned in favour of the Mk.IV, the first prototype for which was a converted F.Mk.I (Z2118) powered by a 2,330 h.p. Griffon 72. As flown in 1944, this prototype retained the elliptical wing and original tail assembly of the Firefly I, but in 1945 the wingtips were clipped and the leading edge of the fin was extended forward in a convex curve. The radiators were moved to the wing root leading edges. Three further Mk.I airframes (Z1835, MB649 and PP482) were modified as prototypes of the Firefly IV, and the first production F.R.Mk.IV (TW687) flew for the first time on May 25, 1945 with a 2,245 h.p. Griffon 74 engine. Deliveries of the Mk.IV Firefly to the Fleet Air Arm did not commence until after the war, Nos. 810 and 825 Squadrons re-equipping with this variant in 1947.



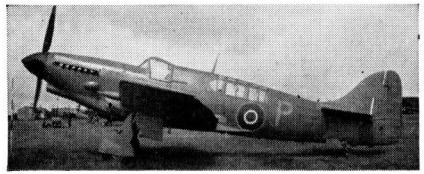


An early production Firefly F.R.Mk.IV (TW729). This version was too late to see operational service.

At the end of the war, the Fleet Air Arm had four operational squadrons of Fireflies with the British Pacific Fleet, the type gaining the distinction of becoming the first British aircraft to fly over Tokio in World War II. and four other squadrons were working up in the United Kingdom.



(*Above*) *The prototype Firefly III (Z1835) and* (*below*) *the prototype Mk.IV (Z2118).*



The following specification relates to the Firefly F.R.I, figures in parentheses referring to the F.R.Mk.IV.

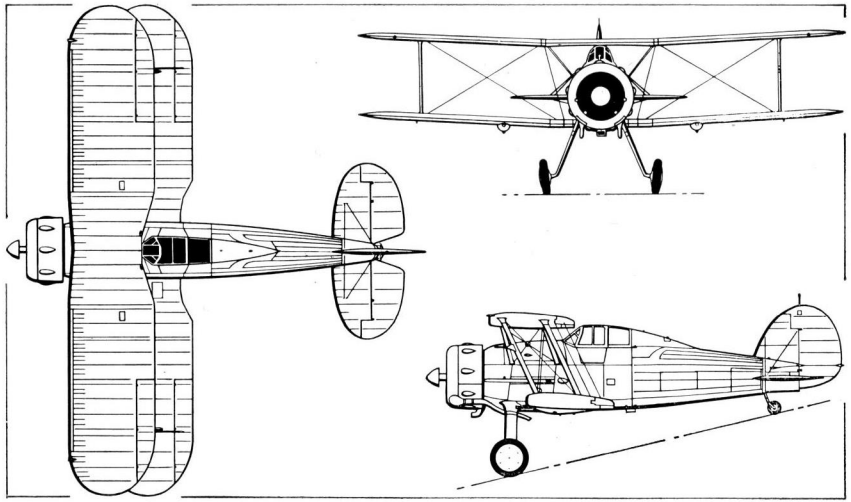
Type: *Two-seat Shipboard Reconnaissance Fighter.* **Power Plant:** *One* 1,730 (2,245) *h.p. Rolls-Royce Griffon IIB* (74) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano cannon plus* 8 (16) 60-*lb rocket projectiles or two* 1,000-*lb. bombs.* **Performance:** *Maximum speed,* 316 (386) *m.p.h. at* 14,000 *ft.; maximum range* (*with drop tanks*), 1,070 (1,300) *mls.; climb to* 10,000 *ft.,* 5 *min.* 45 *sec.* (7 *min.* 9 *sec.*); *service ceiling,* 28,000 (28,800) *ft.* **Weights:** *Empty,* 9,750 (9,674) *lb.; maximum loaded,* 14,020 (14,200) *lb.* **Dimensions:** *Span,* 44 *ft.* 6 *in.* (41 *ft.* 2 *in.*); *length,* 37 *ft.* 7¼ *in.* (37 *ft.* 11 *in.*); *height.* 13 *ft.* 7 *in.* (14 *ft.* 4 *in.*); *wing area,* 328 (330) *sq. ft.*

GLOSTER GLADIATOR

GREAT BRITAIN

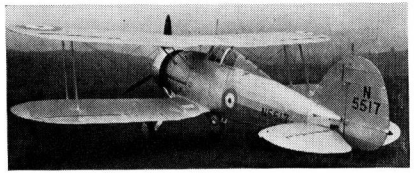
The Gladiator marked the end of the era of the single-seat fighter biplane in the R.A.F. and the F.A.A. Indeed, it was one of the last three warplanes of this type to see operational service, the others being the Fiat C.R.42 Falco and the Polikarpov I-153, yet despite its obsolescence, the Gladiator enjoyed a distinguished wartime career. Evolved by a team headed by H. P. Folland, the Gladiator was an extensively refined development of the Gauntlet, and was produced as a private venture to the specification F.7/30. Possessing the works designation S.S.37, the prototype, to which the serial K5200 was later applied, was powered by a 645 h.p. Bristol Mercury VIS air-cooled radial in a short-chord cowling, carried two Vickers and two Lewis machine guns, and flew for the first time in September 1934.

The S.S.37 was exhaustively tested and, in July 1935, twenty-three machines (commencing K6129) were ordered for the R.A.F. to specification F.14/35, the name Gladiator thereupon being adopted. Three months later, a further



(*Above*) *The prototype of the Gladiator, the S.S.*37.

(*Above*) *A Gladiator II of No.* 25 *Squadron and* (*below*) *the eighteenth production Sea Gladiator.*



186 Gladiators were ordered (commencing K7893), and the first production Gladiator Is were delivered to the R.A.F. in July 1936, entering service with Nos. 3 and 72 Squadrons in January 1937. The Gladiator I differed from the S.S.37 in having an 840 h.p. Mercury IX engine, an enclosed cockpit, and an armament of four Browning guns.

Late-production machines were fitted with metal fixed-pitch three-blade Fairey-Reed airscrew in place of the wooden fixed-pitch airscrew and a shadow-built Mercury VIIIA engine with automatic-mixture-control carburettor and Hobson control box. Commencing N2265 and designated Gladiator II, this variant was produced to specification F.36/37 and had full desert equipment, including sand excluders and a Vokes air cleaner. The last Gladiator II was delivered to the R.A.F. in April 1940, bringing total production, apart from export machines, to 311 aircraft. Of these, thirty-eight (N2265 to N2302) were modified as interim Sea Gladiators for the Fleet Air Arm, and a further sixty (commencing N5500) were built from the outset as Sea Gladiators. These differed from their R.A.F. counterpart primarily in having an arrester hook, catapult points, and a fairing beneath the fuselage for a collapsible dinghy.

Sea Gladiators first embarked aboard H.M.S. *Courageous* in May 1939 with No. 801 Squadron. During 1940 the Sea Gladiator fought both in the Mediterranean and the North Sea with Nos. 804 and 813 Squadrons, but the best-known action in which Sea Gladiators participated was the epic defence of Malta. In April 1940, four Sea Gladiators intended for service aboard H.M.S. *Glorious* and crated at Kalafrana, Malta, were assembled in order to provide a fighter defence for the island. One machine was kept in reserve, and the others, dubbed *Faith*, *Hope* and *Charity*, fought alone against the Regia Aeronautica for eighteen days, until the arrival of Hurricanes.

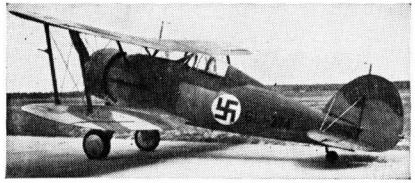
A Gladiator of the Swedish volunteer unit, F 19, *in Finland during the early months of* 1940.

During their service, the trio was fitted with Mercury XV engines and variable-pitch airscrews intended for Blenheim bombers.

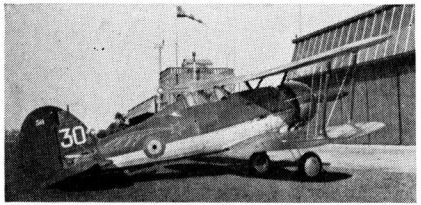
Thirteen of R.A.F. Fighter Command's thirty-five squadrons were still flying Gladiators at the beginning of the war, and two of these, Nos. 607 and 615 Squadrons, immediately embarked for France as part of the Advanced Air Striking Force. In April 1940, the Gladiators of No. 263 Squadron were sent to the aid of Norway, but only one home-based squadron, No. 247, was still flying Gladiators during the "Battle of Britain", this unit being responsible for the local defence of the Royal Naval Dockyards at Plymouth. Four Gladiator-equipped squadrons, Nos. 33, 80, 94, and 112, fought the Regia Aeronautica over the Western Desert, two of these, Nos. 80 and 112, having already fought over Greece in November 1940. Nos. 2 and 5 Squadrons of the Royal Egyptian Air Force were also equipped with Gladiators but took no active part in the aerial defence of Egypt.

A considerable number of Gladiators were exported abroad, the first overseas orders being placed in 1937 by the Latvian and Lithuanian governments which ordered twenty-six and fourteen fighters of this type respectively. The Chinese government purchased thirty-six Gladiators, and although a considerable proportion of these were destroyed in training accidents or by aerial attack, the survivors achieved many successes against the Japanese, particularly in the protection of the aircraft factory at Siuchow.

The Swedish and Belgian governments respectively ordered fifty-five and twenty-two Gladiators in 1937. In the event, the Swedish



(*Above*) *One of the thirty Sea Gladiators delivered to Finland in January and February* 1940, *and* (*below*) *a Gladiator of the Belgian 1ère Escadrille* ("*La Comète*"). *Twenty-two Gladiators were delivered to Belgium, fifteen of these being on strength on May* 10, 1940.



government relinquished thirty of its Gladiators in favour of the Finnish government. These reached Finland in January and February 1940, in time to see action against the Russians with the Finnish No. 26 Squadron. The machines delivered to Finland were actually Sea Gladiators. The twenty-five Gladiators acquired by Sweden entered service with the Flygyapnet as the J8 and J8A, the latter having a Nohab-built Mercury VII engine of 740 h.p. Twelve of these equipped the Swedish volunteer unit, F 19, which fought the Russians in Finland from January 12 to March 30, 1940. The Belgian Gladiators equipped the 1*ère Escadrille de Chasse* at Diest, and had fifteen fighters of this type on strength when German forces attacked Belgium on May 10, 1940.

Twelve Gladiators were delivered to the Norwegian Army Air Force in the summer of 1938 to equip that air arm's sole fighter squadron, but only seven of these were serviceable when Norway was invaded on April 9, 1940. Fifteen Gladiators were purchased by Iraq and all but five of these were destroyed by the R.A.F. during the abortive Axis-inspired revolt of May 2, 1941. Four Gladiators were supplied to Eire, thirty went to Portugal, and two were presented to the Royal Hellenic Air Force as gifts, bringing the total number of Gladiators experted to 216 machines and total production of all fighters of this type to 527 machines.

By the end of 1940, the Sea Gladiator had been largely supplanted by the Grumman Martlet aboard British carriers, and during 1941 the last operational Gladiators with the R.A.F. were withdrawn.

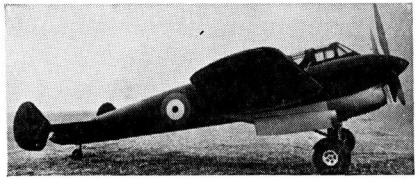
The following specification relates to the Gladiator I, figures in parentheses referring to the Sea Gladiator.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 840 *h.p. Bristol Mercury IX* (*VIIIA*) *nine-cylinder radial air-cooled engine.* **Armament:** *Four* 0.303-*in. Browning machine guns.* **Performance:** *Maximum speed,* 253 (245) *m.p.h. at* 14,500 (15,000) *ft.*; *cruising speed,* 212 *m.p.h. at* 15,500 *ft.*; *range,* 410 *mls.*; *initial climb rate,* 2,350 (2,300) *ft./min.*; *time to* 5,000 *ft.,* 1.9 *min.*; *to* 10,000 *ft.,* 3.8 *min.*; *to* 15,000 *ft.,* 5.8 *min.*; *to* 20,000 *ft.,* 9 (9.5) *min.*; *service ceiling,* 33,000 (32,000) *ft.* **Weights:** *Empty,* 3,476 (3,745) *lb.*; *loaded,* 4,750 (5,420) *lb.* **Dimensions:** *Span,* 32 *ft.* 3 *in.*; *length,* 27 *ft.* 5 *in.*; *height,* 10 *ft.* 4 *in.*; *wing area,* 323 *sq. ft.*

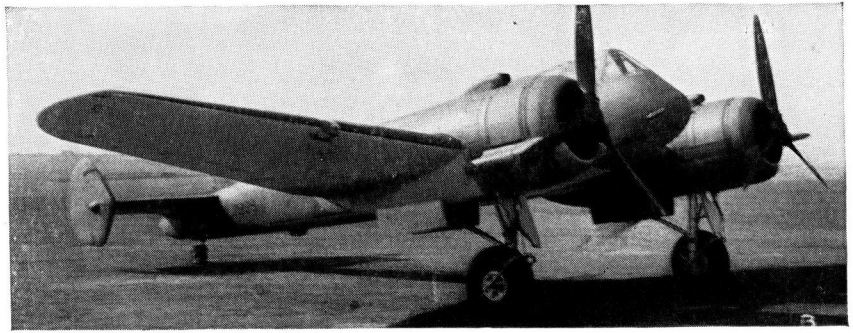
GLOSTER F.9/37 GREAT BRITAIN

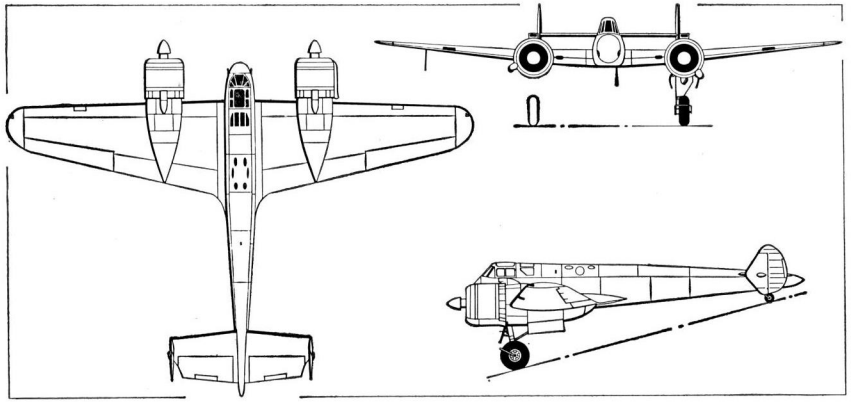
More or less contemporary with the Whirlwind and the Beaufighter, the Gloster F.9/37 was a single-seat twin-engined fighter of considerable merit which, but for an accident during its early trials at Martlesham, might have attained production status. Highly manoeuvrable and extremely docile, the Gloster fighter was never allocated a designation by its manufacturer and was always, therefore, known by the number of the specification to which it was designed. This specification, F.9/37, succeeded an earlier specification, F.34/35, calling for a twin-engined two-seat fighter mounting a four-gun power-operated turret. This requirement was abandoned with the acceptance of the single-engined Boulton Paul Defiant but, some eighteen months later, with the issue of F.9/37, Gloster submitted a design based on the project prepared for the earlier specification but with nose-mounted guns in place of a turret. This was the first Gloster design by W. G. Carter, and a contract was received for two prototypes (L7999 and L8002), one powered by Taurus air-cooled radials and the other powered by liquid-cooled Peregrines.

The first F.9/37 prototype powered by Taurus TE/1 radials was flown for the first time on April 3, 1939, and proved itself to be one of the most manoeuvrable and stable aircraft built at that time, and a delight to fly,



(*Below*) *The first prototype F.*9/37 (*L*7999) *and* (*above, right*) *the second prototype* (*L*8002).





but in July 1939, when the prototype was delivered to Martlesham for official trials, it was severely damaged in a landing accident, and the wrecked aircraft had to be returned to Gloster Aircraft for reconstruction. Owing to some teething troubles with the Taurus TE/1 engines, the later Taurus IIIs were installed, but the new motors were de-rated to 900 h.p. as compared with the 1,050 h.p. offered by the Taurus TE/1, and, in consequence, when trials were resumed in the spring of 1940, maximum speed had dropped from 360 m.p.h. to 332 m.p.h. at 15,200 ft.

In the meantime, the second prototype (L8002) had been completed with two 885 h.p. Rolls-Royce Peregrine liquid-cooled engines, and this aircraft, which was flown for the first time on February 22, 1940, attained a maximum speed of 330 m.p.h. at 15,000 ft. During trials, which were completed in July 1940, the service load of 1,415 lb. carried included ballast to represent the weight of a second crew member, the design being tendered to meet the requirements of specification F.18/40. This specification called for a two-seat fixed-gun day and night fighter powered by Rolls-Royce Merlins, but the modified design proceeded no further than the mock-up stage.

Type: *Single-seat Day and Night Interceptor and Escort Fighter.* **Power Plants:** *Two* 1,050 *h.p. Bristol Taurus TE/1 fourteen-cylinder air-cooled radial engines.* **Armament:** *Two* 20-*mm. Hispano cannon and four* 0.303-*in. Browning machine guns.* **Performance:** *Maximum speed,* 360 *m.p.h. at* 15,000 *ft.,* 354 *m.p.h. at* 16,000 *ft.; initial climb rate,* 2,030 *ft./min.; maximum climb rate,* 2,460 *ft./min. at* 12,000 *ft.; service ceiling,* 30,000 *ft.* **Weights:** *Empty,* 8,828 *lb.; loaded,* 11,615 *lb.* **Dimensions:** *Span,* 50 *ft.* 0 *in.; length,* 37 *ft.* 0 *in.; height,* 11 *ft.* 7 *in.; wing area,* 386 *sq. ft.*

GLOSTER METEOR I AND III

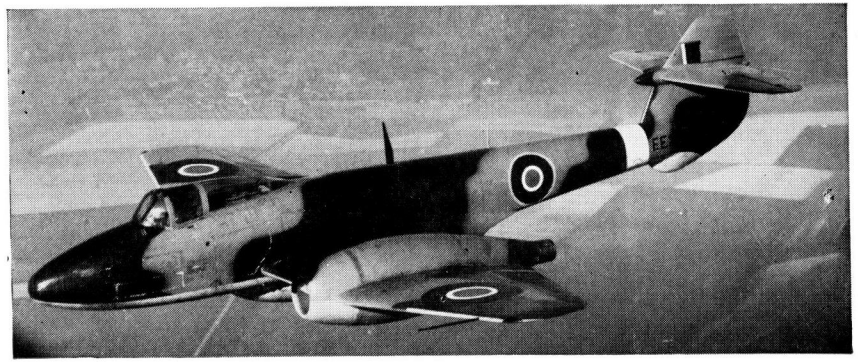
GREAT BRITAIN

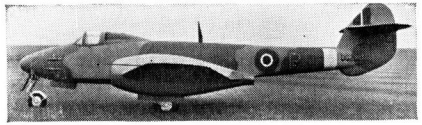
Early in 1940, Gloster Aircraft's design staff headed by W. G. Carter was entrusted with the design of a single-seat interceptor fighter to specification F.9/40, the first specification ever prepared in Britain for an operational jet aircraft. The result, the Meteor, was the first jet aircraft to enter squadron service with the R.A.F., and the only Allied jet aircraft to see operational service during World War II.

A conventional twin-engined layout was adopted for the new fighter from the outset as the absence of any single turbojet offering sufficient thrust to provide the required performance dictated the use of two power plants, and on February 7, 1941, the Ministry of Aircraft Production placed an order or twelve prototypes (DG202-213 inclusive), simultaneously ordering the manufacture of jigs and tools for the production of the new fighter at a rate of eighty machines per month. In the event, only eight of the prototypes were completed, the first of these (DG202/G) commencing taxi-ing trials on July 3, 1942, powered by two de-rated Rover W.2B turbojets. These were non-flying engines each offering 1,000 lb.s.t. After the completion of ground trials, this prototype was returned to Gloster Aircraft to await the delivery of the more powerful Power Jets W.2/500 turbojets, but due to difficulties with these engines, Rover B.23s rated at 1,526 lb.s.t. were installed in their place, DG202/G eventually flying for the first time on July 24, 1943.

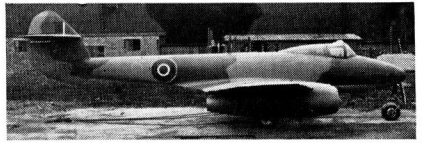
In the meantime, examples of the Halford H.1 turbojet rated at 1,500 lb.s.t. became available, and a pair of these were installed

The fifth production Meteor I (EE214) was one of the first two machines delivered to No. 616 *Squadron.*

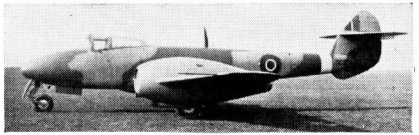




(*Above*) *The first Meteor prototype* (*DG*202).



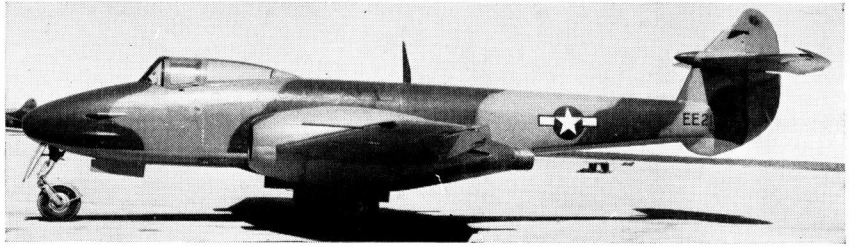
(*Above*) *The third Meteor prototype* (*DG*204).

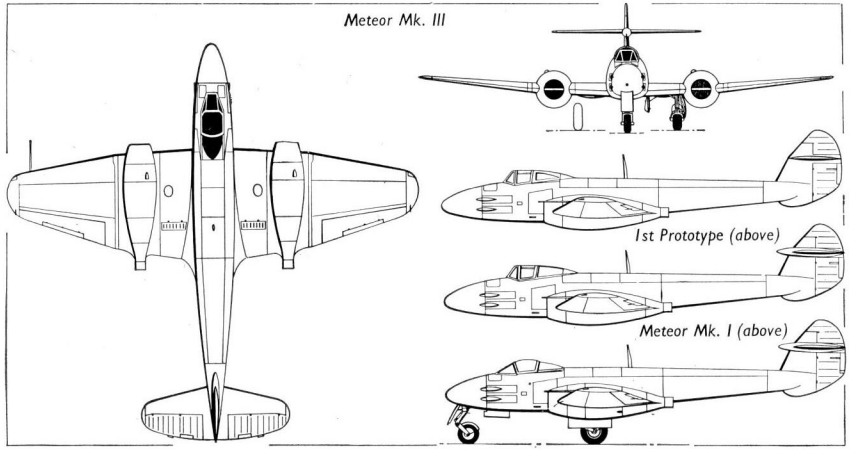


in the fifth prototype airframe (DG206/G) which became the first aircraft of the series to fly, on March 5, 1943. The sixth airframe (DG207/G) was also fitted with H.1 engines and had a pressure cabin. A variety of other engines were tested in the prototypes: DG203 was tested with 1,640 lb.s.t. Power Jets W.2/500s and 2,000 lb.s.t. W.2/700s; DG204 had 2,000 lb.s.t. Metrovick F.3/1s; DG205 had 1,600 lb.s.t. Rolls-Royce W.2B/23s; DG208 had 2,000 lb.s.t. Rolls-Royce W.R.1s, and DG209 had Rolls-Royce W.2B/37s (predecessors of the Derwent) of similar thrust.

Long before the first prototype had flown, Gloster Aircraft had received an initial production order. This order, placed in September 1941, called for twenty aircraft to which the name Thunderbolt was allocated. This name was officially changed to Meteor in March 1942 as a result of the use of the name Thunderbolt for the Republic P-47. The selected power plants for the twenty Meteor Is (EE210-229 inclusive) were Rolls-Royce W.2B/23 Welland Is each rated at 1,700 lb.s.t., and in accordance with an agreement with the U.S.A., the first production Meteor I (EE210) was

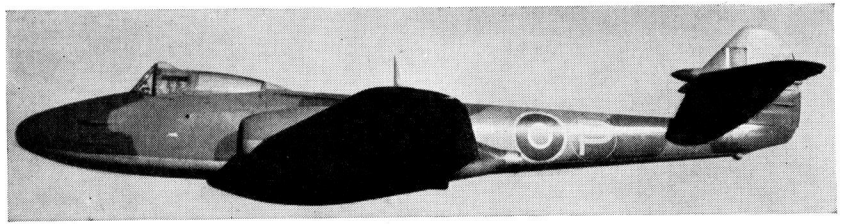
(*Above, left*) *The Halford-powered fifth prototype* (*DG*206) *and* (*below*) *the first Meteor I in U.S.A.A.F. insignia.*

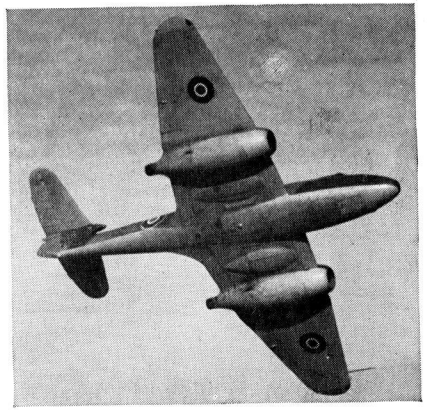




shipped to the U.S.A. in exchange for a Bell YP-59A Airacomet in 1944. Of the twenty Meteor Is built, only sixteen were delivered to the R.A.F. (EE213-222 and EE224-229), the others being used for trials purposes. No. 616 Squadron was selected to re-equip with the new jet fighter, receiving its first two Meteor Is on July 21, 1944. These (EE213 and 214) were not fully operational and were employed for training purposes, but five fully effective Meteor Is reached the squadron two days later, and on August 4th one of these (EE216) scored the first confirmed victory by a British jet fighter when, after its guns had jammed, it destroyed a V-1 missile by tipping it over with its wingtip and thus causing it to crash.

The Meteor II was a proposed production version powered by 2,700 lb.s.t. de Havilland Goblin I turbojets, and the Meteor III was the first version of the fighter to be manufactured in quantity for the R.A.F. The first fifteen Meteor IIIs (EE230-244 inclusive) differed from the Mk.I solely in having a sliding cockpit canopy in place of the sideways-hinging canopy, increased fuel tankage, and some airframe refinements. The sixteenth (EE245) and subsequent Meteor IIIs received W.2B/37 Derwent I engines rated at 2,000 lb.s.t. Welland-powered Meteor IIIs were issued to one flight of No. 616 Squadron which joined the 2nd T.A.F. at Nijmegen from where they undertook their first operational sortie on April 16, 1945. They were joined on the Continent by the Meteor IIIs of No. 504





(*Above*) *The third Meteor I and* (*left*) *a Meteor III.*

Squadron, but sparse enemy aerial opposition resulted in the new jet aircraft being employed principally for ground attack, and the Meteor never had an opportunity to show its paces against Luftwaffe jet fighters.

The Meteor III continued in production until superseded on the assembly line by the Meteor IV in 1945, the last fifteen Mk.III fighters having the lengthened engine nacelles which were adopted as standard for the Derwent V engines of the Mk.IV. A Meteor III (EE360) was fitted with 3,500 lb.s.t. Derwent V engines with which it flew in July 1945, as the prototype Mk.IV. Two hundred and eighty Meteor IIIs were produced (terminating with EE599), but the majority of these did not enter service until after the termination of hostilities.

The following specification relates to the Meteor I, figures in parentheses referring specifically to the Meteor III.

Type: *Single-seat Interceptor Fighter.* **Power Plants:** *Two* 1,700 (2,000) *lb.s.t. Rolls-Royce Welland I* (*Derwent I*) *centrifugal compressor turbojets.* **Armament:** *Four* 20-*mm. Hispano Mk. III cannon.* **Performance:** *Maximum speed,* 385 (458) *m.p.h. at sea level,* 410 (493) *m.p.h. at* 30,000 *ft.; range* .(1,340) *mls. at* (350) *m.p.h. at* (30,000) *ft.; initial climb rate,* 2,155 (3,980) *ft./min.; service ceiling,* 40,000 (44,000) *ft.* **Weights:** *Empty,* 8,140 (8,810) *lb.; loaded,* 11,800 (13,300) *lb.* **Dimensions:**, *Span,* 43 *ft.* 0 *in.; length,* 41 *ft.* 3 *in.; height,* 13 *ft.* 0 *in. wing area,* 374 *sq. ft.*

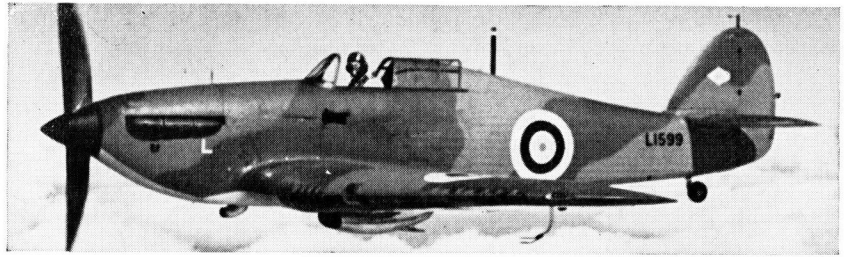
HAWKER HURRICANE I — GREAT BRITAIN

One of military aviation history's most outstanding machines, the Hurricane opened a new era in R.A.F. fighter equipment, being both the first interceptor monoplane to be adopted by that service and its first combat aircraft capable of exceeding 300 m.p.h. in level flight. Of slightly less advanced conception than the contemporary Spitfire, it was something of a disappointment in fighter-versus-fighter combat with the Messerschmitt Bf 109E, being undoubtedly at a disadvantage at altitude. It was inferior to its German opponent in climb and level speed at all altitudes, but it possessed a marked edge in manoeuvrability up to 20,000 feet, out-turning the Bf 109E with ease, and was an excellent gun platform. Capable of absorbing a tremendous amount of battle damage, it was numerically the most important British fighter in service until the end of 1940, and its supreme versatility was never surpassed, its propensity for adaptation becoming legendary.

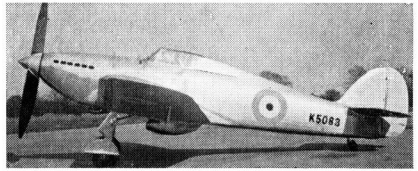
Design work on the monoplane upon which the name Hurricane was eventually to be bestowed began as a private venture in January 1934 when Sydney Camm, chief designer of Hawker Aircraft, learned of the work being undertaken by Rolls-Royce on a powerful new liquid-cooled engine, the PV-12. Prior to this, Camm had been working on a fighter project known as the "Fury Monoplane" powered by a Rolls-Royce Goshawk steam-cooled engine, and this project was entirely re-worked to take the PV-12, stressing commencing in March 1934 and work on detailed drawings beginning in May. The detailed design, around which specification F.36/34 was eventually written, was submitted to the Air Ministry on September 4, 1934, and although instructions to proceed with the construction of a prototype were not given until January 10th of the following year, preparatory work began on October 17, 1934. At this time the proposed armament comprised two fuselage-mounted Vickers Mk.V machine guns and two wing-mounted Brownings, but on July 20, 1935, the contract was amended to provide for the installation of eight wing-mounted Brownings.

Powered by a 990 h.p. Merlin "C" engine—this name having been allocated to the PV-12—driving a Watts two-blade fixed-pitch wooden airscrew, the prototype (K5083) flew for the first time on November 6, 1935, being delivered to Martlesham Heath for official trials during the following February. The results of these trials met the most sanguine of expectations, a maximum speed of 315 m.p.h. being attained in level flight at 16,200 feet, and, convinced that quantity production orders were forthcoming, Hawker Aircraft prepared plans for the production of one thousand machines on their own initiative. In fact, on June 3, 1936, an initial quantity of six hundred was officially ordered and, three weeks later, the name "Hurricane" was approved. Production drawings began to reach the shops during the same month, and although some delay resulted from the decision to supplant the Merlin I by the Merlin II, necessitating some redesign, the first production Hurricane I (L1547) flew on October 12, 1937.

Deliveries to the R.A.F. followed rapidly, and the first unit to re-equip with the Hurricane, No. 111 Squadron at Northolt, had one flight of the monoplanes by December 1937 and completed re-equipment in January 1938, Nos. 3 and 56 Squadrons converting to the Hurricane shortly afterwards. The Hurricane's structure was a logical development of the methods of construction employed by its biplane predecessors. The retention of fabric covering instead of metal stressed skin was largely due



(*Below, left*) *The prototype Hurricane* (*K*5083) *and* (*above*) *The 52nd production Mk.I* (*L*1599).



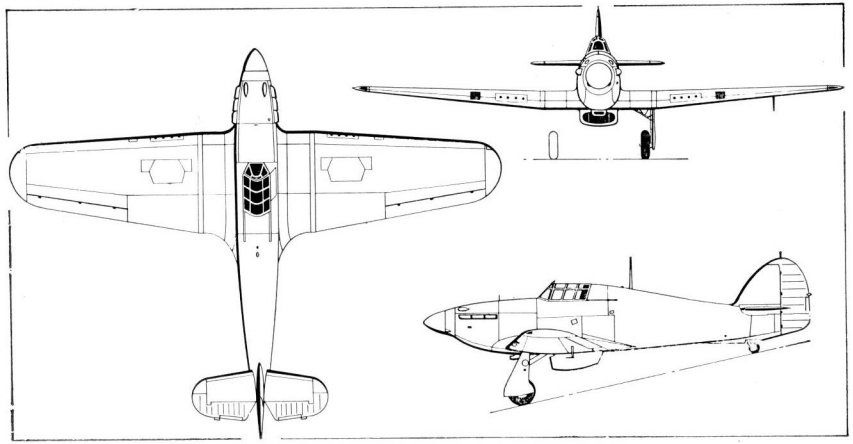
to the fact that Hawker had no facilities for the latter, and the use of well-tried methods permitted production tempo to be built up rapidly.

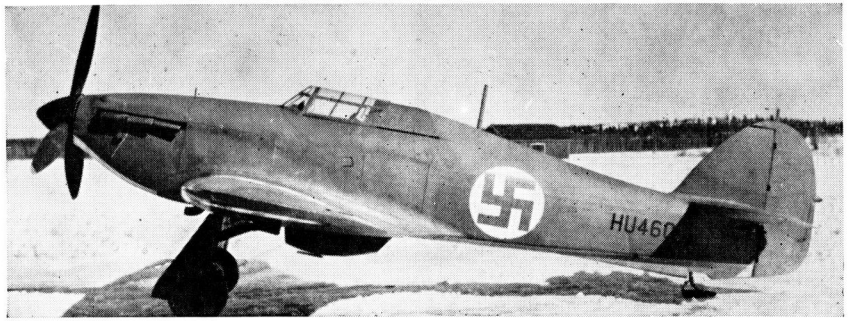
The first production Hurricane Is were entirely fabric-covered and had no bullet-proof windscreen or armouring. Their Merlin II engines which were rated at 1,030 h.p. at 16,250 ft. drove Watts fixed-pitch two-blade airscrews and gave a maximum speed of 318 m.p.h. at 17,400 ft. An altitude of 20,000 ft. was attained in 11.7 min., an initial climb rate of 2,050 ft./min. increasing to 2,450 ft./min. at 11,000 ft., and service ceiling was 33,400 ft. The substitution of de Havilland two-position three-blade airscrews and, subsequently, de Havilland or Rotol constant-speed airscrews for the Watts two-blader resulted in marginal performance increases, and the Merlin III engine was introduced which, having a similar output to that of its predecessor, had a standardised shaft for de Havilland or Rotol constant-speed airscrews. This engine was standardised on all Hurricanes of the second production contract which called for three hundred machines. These aircraft also featured a bullet-proof windscreen.

While the Hurricane's fuselage was to retain its fabric covering throughout its production life, the investigation of the use of metal stressed-skin for the wings had commenced as early as July 1935, and such wings were first flown (on L1877) on April 28, 1939. These wings were introduced on Hurricanes of Hawker's second production contract, the first production machine so fitted being N2422. The metal-covered wings were fitted to machines at intervals along the production line until their manufacture permitted a complete changeover. The first Hurricanes with metal wings were delivered to the R.A.F. on September 29, 1939. Considerable priority was given to work on providing the Hurricane with armour protection for the pilot and increasing

the fighter's firepower, and an early Hurricane I (L1750) was fitted with armour and, on May 24, 1939, flew with a 20-mm. cannon under each wing. In this connection, it is of interest to note that on February 21, 1936, Hawker tendered a version of the Hurricane to meet specification F.35/35 in which four 20-mm. Oerlikon cannon were mounted in the wings. The *official* opinion was that a quartette of 20-mm. guns could not be satisfactorily accommodated by a *single-engined* fighter, and the proposal was turned down! The first Hurricane with interim armour (i.e., pilot protection only) appeared on February 2, 1940, and it is a little-known fact that a Hurricane I (V7260) fitted with four 20-mm. Oerlikon cannon fought in the "Battle of Britain", flying from North Weald, and five additional aircraft were in process of being fitted with four-cannon wings, these being machines that had suffered damage in the vicinity of the gun bays, but they were too late to participate in the "Battle".

By the end of 1938, plans were in hand to boost Hurricane production substantially, and preparations had been completed for the production of Hurricane fighters by Gloster Aircraft, half of Hawker's third production contract (for one thousand aircraft) being passed to Gloster, this company producing its first Hurricane (P2535) on October 27, 1939, delivering one thousand machines by the end of 1940, and attaining a peak production rate of 130 Hurricanes per month. A total of 1,924 Hurricane Is was eventually completed by the parent company and 1,850 by Gloster. Plans were also prepared for producing Hurricanes in Canada by the Canadian Car and Foundry Company, this concern completing





One of twelve Hurricane Is exported to Finland and employed against the Soviet Air Forces.

its first Hurricane I (P5170) on January 9, 1940, subsequently building a further 1,450 machines. Initially these were similar in all respects to British-built Hurricane Is, but from mid-1941 onwards, Packard-built Merlin engines became available for installation, and subsequent machines, corresponding to the Hurricane IIB, were allocated a new series of mark numbers.

Appreciable foreign interest in the Hurricane was manifested from an early stage in the fighter's career, and export orders were soon received. It is surprising that, in view of the R.A.F.'s urgent requirements and the international situation, these export orders were fulfilled. Yugoslavia was one of the first foreign customers for the Hurricane, and in addition to ordering an initial batch of twelve machines followed by an order for a further batch of twelve, this country acquired a manufacturing licence for the fighter. Delivery of the first batch to Yugoslavia commenced on December 15, 1938, and the second batch of twelve was shipped in February 1940. The Yugoslav government placed orders for forty Hurricanes with the Rogožarski factory and a further sixty were ordered from the Zmaj plant, a monthly delivery rate of eight machines from each concern being anticipated by mid-1941. In fact, less than twenty Hurricanes had been completed by Rogožarski and Zmaj by April 6, 1941, on which date the Luftwaffe opened its assault on Yugoslavia. On April 6th, the Royal Yugoslav Air Force possessed thirty-eight Hurricanes. Of these, eighteen formed the 51st Squadron of the 2nd Fighter Regiment, fourteen formed the 33rd Squadron of the 4th Fighter Regiment, and the remaining six, together with eight IK-2s, equipped the 34th Squadron of the last-mentioned Regiment. The Hurricanes saw considerable action over Zagreb and Bosnia as interceptors and were also used to strafe the advancing German columns, flying operationally for the last time on April 13, 1941. Subsequently, German forces approached the bases from which the

remaining Hurricanes were operating and, as fog prevented their evacuation, they were destroyed by their pilots. One Hurricane airframe was fitted experimentally with a Daimler-Benz DB 601A engine for comparison purposes with the Merlin at the request of the Royal Yugoslav Air Force. The conversion was made by engineers Ilič and Sivčev in an Air Force hangar at Zemun, the new engine bearers, cowlings and cooling system being manufactured by the Ikarus factory. The DB 601A-powered Hurricane flew successfully early in 1941, and was generally considered by Yugoslav test pilots to be superior to the Merlin-powered standard model. The Iranian government ordered a few Hurricanes, the first of these being delivered in August 1939. Only one other Hurricane reached Iran, and this did not arrive until 1940. Rumania ordered twelve machines, the delivery of which commenced on August 28, 1939, and fifteen were delivered to Turkey during September and October 1939. One Hurricane (L2048) was shipped to Poland for evaluation on July 24, 1939, but a further nine aircraft shipped to the Polish Air Force did not reach Poland before the country was overrun, and these were subsequently diverted to the Middle East.

Belgium was another purchaser of the Hurricane, twenty being supplied to that country which also acquired a manufacturing licence. Production was initiated by Avions Fairey at Gosselies, eighty Hurricane Is being ordered from that concern. The Belgian Hurricane was to have differed from British-built machines in having a wing-mounted armament of four 12.65-mm. Browning guns. Only two Belgian-built Hurricanes were actually test flown before the German onslaught, an additional airframe awaiting the arrival of an engine at this time. Twenty Hurricanes from the first production batch were shipped to Canada in 1939, together with a pattern aircraft (L1848) and one machine (L2144) as "sample material". Three machines from this batch were also shipped to South Africa, and a further twelve Hurricanes were delivered to Finland. Thus, despite the pressing needs of the R.A.F., more than a hundred Hurricanes were exported!

At the beginning of the Second World War, Hawker Aircraft had delivered 497 Hurricanes, and eighteen R.A.F. Fighter Command squadrons were fully equipped with the type, two of these, Nos. 1 and 73 Squadrons, being despatched to France as part of the Advanced Air Striking Force, and two more, Nos. 85 and 87 Squadrons, arriving in France shortly afterwards as a part of the Air Component of the British Expeditionary Force. Within hours of the German offensive of May 1940, six more Hurricane squadrons had been despatched to France, and two more followed later, but seventy-five of their aircraft were destroyed and a further 120 Hurricanes were damaged and had to be abandoned—representing about a quarter of the R.A.F.'s then current fighter strength. Immediately prior to the "Battle of Britain" there were twenty-six Hurricane squadrons of which three were only partly operational and four were re-equipping after losing most of their machines in France, but by August 8, 1940, when a total of 2,309 Hurricane Is had been delivered, the R.A.F.'s order of battle included thirty-two squadrons of Hurricanes as against only nineteen squadrons of Spitfires.

Since that epic conflict a number of disparaging and ill-informed comments have been published concerning the Hurricane's capabilities, some of these being based on Lord Dowding's statement that the average speed of production Hurricanes was 305 m.p.h. This was, in fact, the average speed of *repaired* aircraft whereas new aircraft with the Rotol airscrew attained 324 m.p.h. at rated

altitude. This was, admittedly, substantially below the maximum speed of the Bf 109E, but this performance inferiority was acknowledged, and the Hurricane was largely allocated the task of dealing with the Luftwaffe's bombers while the faster Spitfire kept the escorting fighters occupied, and for this task the Hurricane was magnificent.

The first deployment of the Hurricane overseas following the withdrawal from the European mainland came in August 1940 when No. 261 Squadron reached Malta. Soon afterwards, the Hurricanes of Nos. 73 and 274 Squadrons arrived in the Western Desert. These were equipped with a larger coolant radiator than that of the standard model, and had a Vokes air filter over the intake. These modifications resulted in a reduction in maximum speed to 312 m.p.h. The first tropicalised Mk. I (L1669) had flown on May 17, 1939.

A modified version of the Hurricane especially strengthened for Naval use, the Sea Hurricane IA, appeared in service in 1941. This was intended specifically for operation from CAM-ships (Catapult Aircraft Merchantmen) as a component of the "Catafighter" scheme, and was known unofficially as the "Hurricat". Essentially similar to the Hurricane I—in fact a number were converted from "Battle of Britain" veterans—the Sea Hurricane IA had catapult spools and was mounted on a catapult aboard a merchantman for "one-sortie" type operations against the Fw 200C Condor. The first recorded victory of one of these aircraft came on August 3, 1941, and fifty were allocated from R.A.F. Fighter Command for conversion, and a further fifty earmarked from Canadian production, although all were not employed in the "cata-fighter" role.

The Sea Hurricane IB differed from the IA in having a V-frame arrester hook to permit normal carrier operation and, produced in 1941, was the first British single-seat fighter monoplane to undertake the shipboard role, serving extensively with the Fleet Air Arm, operating widely in the Atlantic and Mediterranean until late in 1943. The Sea Hurricane IC was similar apart from having the four-cannon armament of the more powerful land-based Hurricane IIC. In 1940, incidentally, designs for a folding-wing version of the Hurricane were prepared, but this variant never materialised.

Among numerous interesting experiments conducted with Hurricane Is was that concerning an investigation into the potentialities of "slip" wings to facilitate the take-off of heavily-laden aircraft. For this investigation, which was conducted by F. Hills and Son, L1884 was used, this being one of the original twenty Hurricanes supplied to Canada (and allocated the R.C.A.F. serial number 321) and later returned to the United Kingdom. A second set of wings was mounted on struts above the cockpit, these following the outline of the normal Hurricane wings. It was proposed that they would house fuel tanks and be "slipped" once the fuel that they contained was consumed.

The following specification relates to the standard Hurricane I with Rotol constant-speed airscrew.

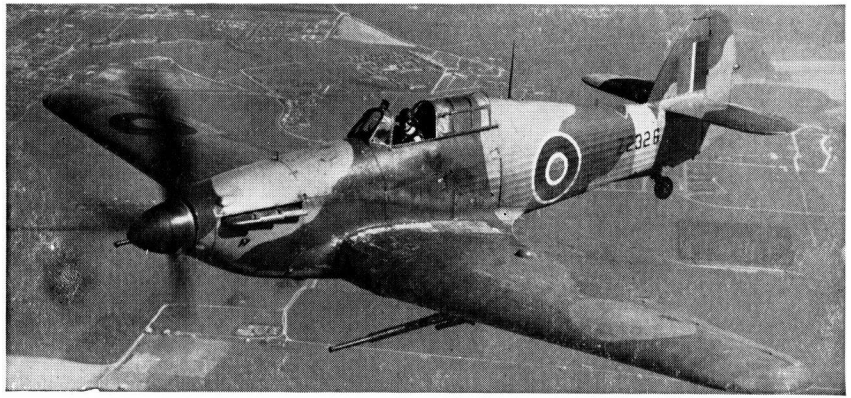
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,030 *h.p. Rolls-Royce Merlin III twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Eight* 0.303-*in. Browning machine guns with* 334 *r.p.g.* **Performance:** *Maximum speed,* 324 *m.p.h. at* 16,250 *ft.,* 254 *m.p.h. at sea level; initial climb rate,* 2,300 *ft./min.; climb rate at* 11,000 *ft.,* 2,420 *ft./min.; service ceiling,* 34,200 *ft.; time to* 15,000 *ft.,* 6.5 *min., to* 20,000 *ft.,* 9.8 *min.; range,* 425 *mls.,* (*with two* 44 *Imp. gal. drop tanks*) 900 *mls.* **Weights:** *Empty,* 4,670 *lb.; normal loaded,* 6,600 *lb.* **Dimensions:** *Span,* 40 *ft.* 0 *in.; length,* 31 *ft.* 11 *in.; height,* 8 *ft.* 9 *in.; wing area,* 257.5 *sq. ft.*

HAWKER HURRICANE II, IV AND V — GREAT BRITAIN

While the Hurricane I was engaging the full weight of the Luftwaffe in the "Battle of Britain", Hawker Aircraft were devoting considerable attention to the further exploitation of the fighter's basic design. Several proposals were made for the installation of alternative power plants to the Merlin III, including the Rolls-Royce Griffon and the Bristol Hercules, but the installation of the two-stage supercharged Merlin XX rated at 1,280 h.p. for take-off offered most promise and, at the same time, called for the least redesign. Thus, a Hurricane I (P3269) was fitted with this engine and flown for the first time on June 11, 1940, serving as a prototype for the Hurricane II.

The first production model with the Merlin XX was an interim version which retained the wings of the Mk.I and was designated Hurricane IIA Series 1. With an empty weight of 5,500 lb. and a maximum loaded weight of 7,100 lb., the Hurricane IIA attained 20,000 ft. in 8.2 minutes and had a service ceiling of 37,000 ft. At 6,800 lb. it had a maximum speed of 322 m.p.h. at 13,500 ft., and 342 m.p.h. at 22,000 ft., and range on internal fuel was 500 mls. at 212 m.p.h. Two new sets of wings had been designed for the Hurricane II at the outset of development, one set housing twelve Browning guns and the other housing four 20-mm. Oerlikon cannon. These wings could also support two 250-lb. or 500-lb. bombs, and strengthened fuselage longerons were

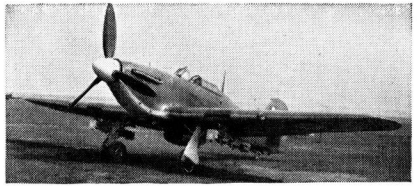
The first Hurricane IID (Z2326) with Rolls-Royce B.F. cannon. These were later enclosed by fairings.



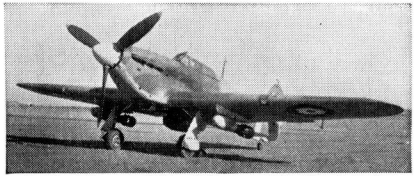
required in association with these changes. The Hurricane IIA Series 2 was a further interim production model featuring the strengthened and slightly lengthened fuselage—the additional length resulting from an extra bay and frame in the forward fuselage—to permit conversion to a later variant but fitted initially with the Hurricane I's eight-gun wing. Some aircraft of this type were used for night fighting with limited results.

The first Hurricane IIA Series 1 fighters began to reach the squadrons from September 4, 1940, Series 2 aircraft following in October, but the Mk.IIB with the twelve-gun wing and the four-cannon Mk.IIC did not reach operational units until 1941, the Hurricane IIBs being first issued to Nos. 601 and 605 Squadrons, and the IICs to Nos. 1 and 3 Squadrons. Hurricane IIB fighter-bombers, dubbed "Hurribombers", were used operationally for the first time on October 30, 1941 when aircraft of No. 607 Squadron began anti-shipping operations in the Channel. During the following month, Hurricane IIB fighter-bombers joined operations in the Western Desert with No. 80 Squadron, and, over Europe, the cannon-armed Hurricane IICs were engaged in night intruder duties. Simultaneously, the Hurricane IIAs and IIBs of Nos. 81 and 134 Squadrons which comprised No. 151 Wing had flown to the Soviet Union to fly with the Russians on the Eastern Front.

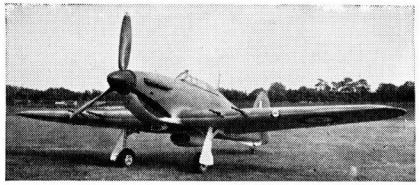
By 1942, the Hurricane was definitely outmoded as an interceptor fighter, but yet another type of wing had been developed for this versatile aircraft, this carrying a 40-mm. tank-busting cannon, and as the Mk.IID the Hurricane took a new lease of life. Early production Hurricane IIDs carried a pair of Rolls-Royce B.F. cannon with twelve rounds per gun, and later machines had two Vickers Type S cannon with fifteen rounds per gun. These were slung under the wings which, themselves, contained a pair of 0.303-in. Brownings for aiming purposes. The first Hurricane IID (Z2326) flew on September 18, 1941, and apart from the first few production machines, aircraft of this type had additional armour protection for the pilot, radiator and engine.



A Hurricane IIA with SBC (Small Bomb Container) equipment.



A Hurricane IIB with two 250-lb. bombs.

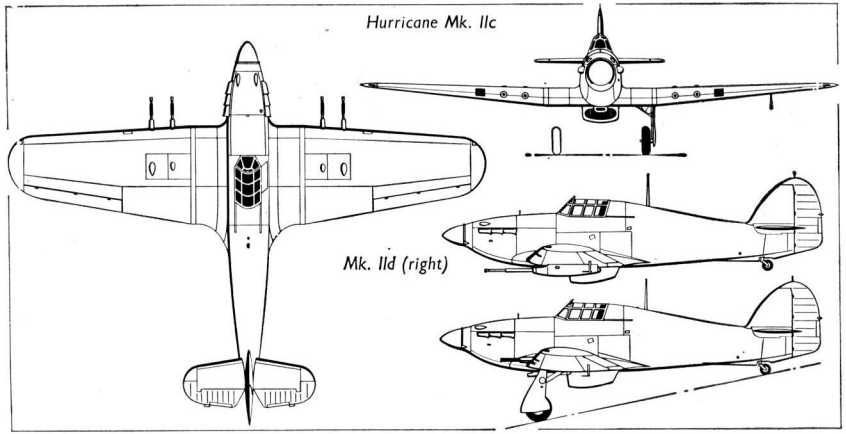


A Hurricane IIC with four Oerlikon cannon.

Only one R.A.F. squadron based in Europe (No. 184) was equipped with the Hurricane IID, but this aircraft soon became the scourge of Rommel's armour in North Africa where it first saw action on June 6, 1942, with No. 6 Squadron. The Hurricane IID weighed 5,700 lb. empty and 8,100 lb. in maximum loaded condition. At a mean weight of 7,700 lb. it attained maximum speeds of 290 m.p.h. at 12,000 ft. and 316 m.p.h. at 19,000 ft. Range was 480 mls. at 176 m.p.h. at 2,000 ft., and service ceiling at maximum loaded weight was 33,500 ft.

A proposal to install Packard-built Merlin engines in British-built airframes did not see fruition, this version being tentatively designated Hurricane III, and in 1943 the final production model, the Hurricane IV, made its début. Originally designated Hurricane IIE (270 machines being delivered before the designation was changed), the Mk.IV featured "low attack" or universal armament wings, these being capable of carrying 40-mm. Vickers cannon, bombs, drop tanks, or "unrifled projectiles" as rocket missiles were originally known. Extensive rocket-launching trials had been undertaken with Hurricanes, commencing early in February 1942 with Z2415 which had three launching rails under each wing. The first flight of the prototype Hurricane IV (KX405) with a Merlin 32 engine driving a four-blade airscrew took place on March 14, 1943, but production machines had either the Merlin 24 or 27 rated at 1,620 h.p.

With eight 60-lb. rocket projectiles, the Hurricane IV had a maximum loaded weight

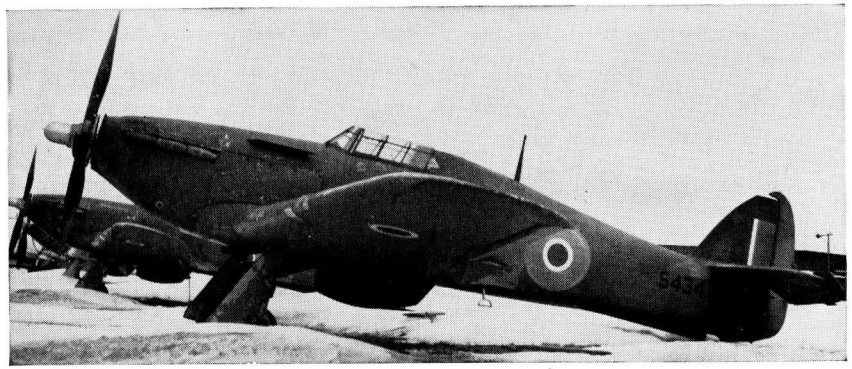


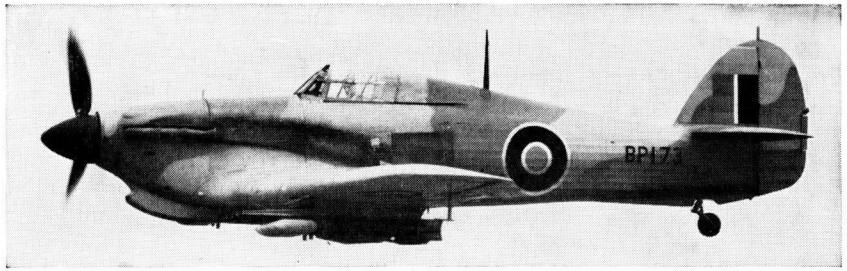
of 8,500 lb., and at a mean weight of 7,700 lb., it attained maximum speeds of 265 m.p.h. at 7,000 ft. and 284 m.p.h. at 13,500 ft. Five hundred and twenty-four Hurricane IVs plus the 270 similar Mk.IIEs were issued to the R.A.F., and these served in Tunisia and Burma. Closely related to the Hurricane IV was the Mk.V which differed only in the type of engine installed—a ground-boosted Merlin 32 rated at 1,635 h.p. for take-off and driving a four-blade airscrew—and two machines of this type (KZ193 and NL255) were converted from Mk.IVs, the first of these flying on April 3, 1943. The engines of these two machines were later changed to Merlin 27s with similar ground-boosted ratings, and finally both aircraft were reconverted to Mk.IVs.

In Canada the introduction of the Packard-built Merlin 28 and Hamilton Standard Hydromatic airscrew on the Canadian Car and Foundry Hurricane assembly line in mid-1941 resulted in the Hurricane X, basically similar to the Mk.IIB. The Hurricane XI was identical to the Mk.X apart from the use of R.C.A.F. rather than R.A.F. equipment, and the principal production versions, the Hurricane XII and XIIA, were powered by the Packard Merlin 29 and carried twelve and eight 0.303-in. guns respectively.

Hurricane IIs and, to a lesser extent, IVs saw widespread service with the Soviet Air Forces, no fewer than 2,952 machines being despatched to Russia, the majority of these being Mks.IIA, IIB and IIC, deliveries commencing in 1941. A number of Canadian-built Hurricane Xs were also received by the Russians, and in the summer of 1943 a number of Mk.IIDs were delivered, followed early in 1944 by some Mk.IVs. The Hurricanes of the R.A.F.'s No. 151 Wing were taken over by

Canadian Car and Foundry-built Hurricane XIIs with Packard Merlin 29 engines.





Predecessor of the Mk.IV, the Hurricane IIE (above) was the first model fitted with universal armament wings.

the 72nd Regiment of the Soviet Naval Air Fleet when the British personnel returned to the United Kingdom. Fourteen Hurricanes (mostly tropicalised Mk.IICs) were supplied to Turkey in 1942; the Royal Egyptian Air Force received about twenty tropicalised Hurricane IIBs and IICs, and the Indian Air Force was supplied with some 300 Hurricane IIBs, IICs, IVs, and XIIs.

Navalised versions of the Hurricane II were also produced, some of these being known as "Hooked Hurricanes" as they had an arrester hook and a position indicator for the hook in the cockpit but retained R.A.F. radio equipment. The Sea Hurricane II had full Fleet Air Arm radio equipment and stowage for signal pistol and cartridges, and the Sea Hurricane XIIA was a navalised version of the Canadian-built Hurricane XIIA. By the end of 1943, the Sea Hurricane had largely given place to Seafires, Hellcats and Wildcats.

The last production Hurricane, a Mk.IIC (PZ865), was delivered by Hawker Aircraft in September 1944, bringing total production to 14,233 machines, comprising 10,030 Hurricanes built by Hawker Aircraft, 2,750 built by Gloster, 1,451 built by Canadian Car and Foundry, and two built by Avions Fairey.

The following specification relates to the Hurricane IIB, figures quoted in parentheses relating to the Mk. IIC.

Type: *Single-seat Fighter and Fighter-Bomber.* **Power Plant:** *One* 1,460 *h.p. Rolls-Royce Merlin XX twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Twelve* 0.303-*in. Browning machine guns with* 332 *r.p.g.* (*four* 20-*mm. Oerlikon cannon with* 90 *r.p.g.*) *plus two* 250-*lb. or* 500-*lb. bombs.* **Performance:** *Maximum speed,* 322 *m.p.h. at* 13,500 *ft.,* 342 *m.p.h. at* 22,000 *ft.; maximum cruising speed,* 296 (292) *m.p.h. at* 20,000 *ft.; range,* (*on internal fuel*) 480 (460) *mls. at* 212 *m.p.h.,* (*maximum external fuel*) 985 (970) *mls.; time to* 20,000 *ft.,* 8.4 (9.1) *min.; service ceiling* (*max. weight*), 36,500 (35,600) *ft.* **Weights:** *Empty,* 5,500 (5,800) *lb.; normal loaded,* 7,000 (7,300) *lb.; maximum,* 7,300 (7,800) *lb.* **Dimensions:** *Span* 40 *ft.* 0 *in.; length,* 32 *ft.* 2½ *in.; height,* 8 *ft.* 9 *in.; wing area,* 257.5 *sq. ft.*

HAWKER TORNADO

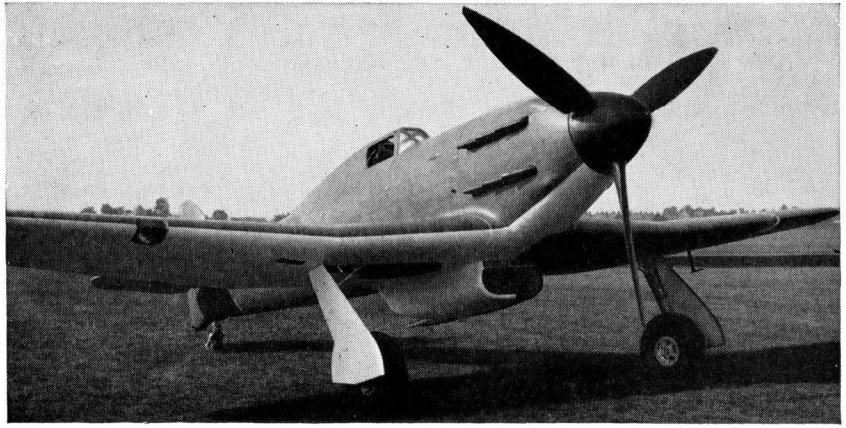
GREAT BRITAIN

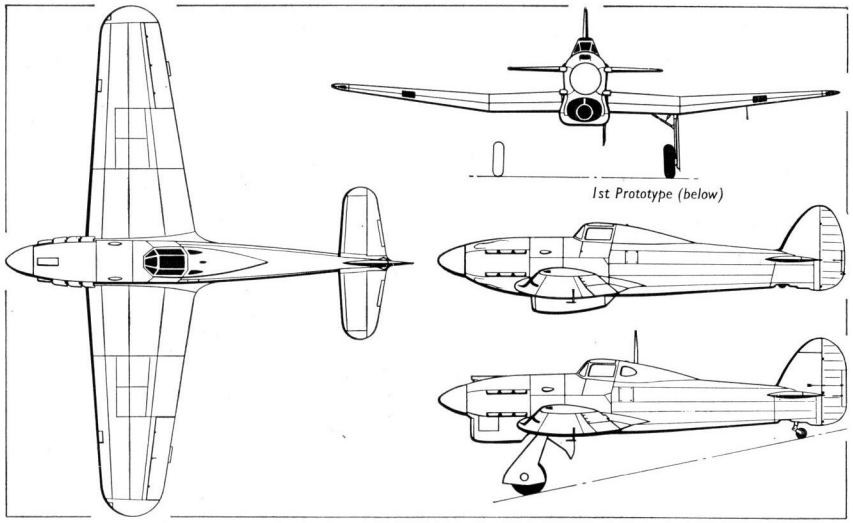
In April 1937, Sydney Camm and his design team began investigating the possibilities of a single-seat interceptor powered by the newly-developed Napier Sabre twenty-four cylinder horizontal-H-type engine which promised outputs in excess of 2,000 h.p. The new fighter was to carry a wing-mounted armament of twelve 0.303-in. Browning machine guns, and in July 1937 the company's proposals and preliminary drawings were submitted to the Air Ministry. At this time an official specification for a 2,000 h.p. fighter on the lines of those proposed by Sydney Camm was already being prepared, and this, specification F.18/37, was issued in January 1938, although details of the required military load were not made available until the following April.

Hawker Aircraft adapted their design proposals to meet the specification's requirements, already having prepared studies for an alternative version of the fighter powered by the Rolls-Royce Vulture X-type engine, submitting their tender to the Air Ministry on April 22, 1938. Four months later, on August 30th, four prototypes were ordered—two to be fitted with the Sabre engine and two with the Vulture.

Structurally, the Vulture-powered Type "R" fighter and the Sabre-powered Type "N" were similar; the front fuselage was of steel-tube

The first prototype Tornado (P5219) with the original ventral radiator bath.





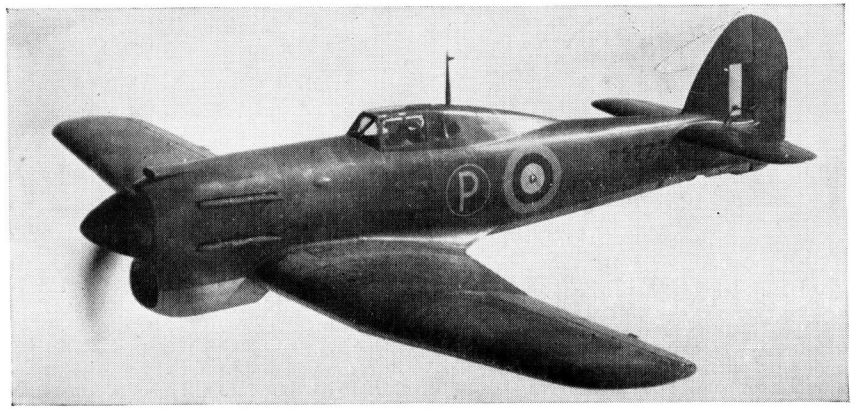
construction, the aft portion consisting of a stressed skin, flush-riveted monocoque, and the wings were all-metal. Prototype construction proceeded in parallel, but the Vulture-powered Type "R", by this time named Tornado, was the first of the two to begin flight trials, this aircraft (P5219) flying for the first time on October 6, 1939. The promise shown during the initial test phase resulted in an order to proceed on 500 Tornados. As flight testing progressed and higher speeds were attained, compressibility effects resulted in adverse air flow conditions round the ventral radiator bath. The radiator was, therefore, moved forward to the nose, and the first prototype Tornado flew for the first time with this modification on December 6, 1939. This first machine was powered by a Vulture II engine rated at 1,760 h.p., had provision for twelve wing-mounted Browning machine guns, and had an all-up weight of 9,250 lb. It was totally destroyed shortly after the test programme was resumed with the new radiator position.

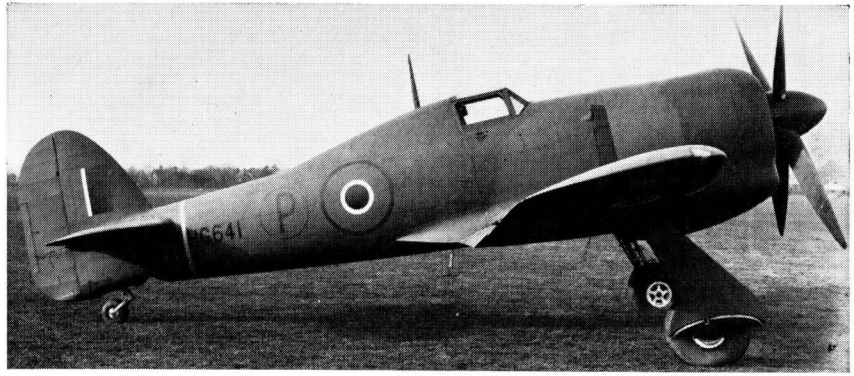
The gravity of the war situation in May 1940 led to the cancellation of all priority for Tornado development in order to allow every effort to be put into the production of the

Hurricane, but by the following October, Tornado production had been reinstated, and a production line had been prepared at the Woodford factory of A. V. Roe. The second prototype Tornado (P5224) flew for the first time on December 5, 1940. It had provision for a wing-mounted armament of four 20-mm. cannon and, like its predecessor, was powered by the Vulture II. Loaded weight was 9,600 lb., but within two months this had grown to 10,580 lb. The Vulture engine was suffering frequent connection-rod bolt failures, and at the beginning of 1941, Hawker were asked to put forward proposals for versions of the fighter with such alternative engines as the Wright Duplex Cyclone Type C, the Bristol Centaurus and the Fairey Monarch. In March 1941, the Vulture II was supplanted in the second prototype by the improved Vulture V of 1,980 h.p., but, shortly afterwards, the Vulture was removed from the aero engine development programme. This decision also cancelled production of the Tornado fighter, and only one production Tornado I (R7936) was delivered from the Woodford assembly line, this making its first flight on August 29, 1941, and being used subsequently as a testbed for de Havilland and Rotol contra-props.

In February 1941, Hawker received a contract to build one additional Tornado prototype, but this was to be powered by a 2,210 h.p. Bristol Centaurus C.E.4S radial air-cooled engine. The modifications necessitated by the installation of the Centaurus included the provision of a new centre fuselage and engine

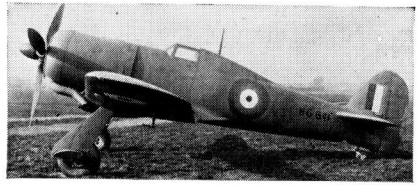
The second prototype Tornado (P5224) which was fitted with the nose-mounted radiator from the outset.





(Above) Tornado HG641 with the enlarged oil cooler duct beneath the nose and (below, right) HG641 in its original form.

mounting, and this machine (HG641) was flown for the first time on October 23, 1941. The Centaurus had an exhaust collector ring forward from which a single external exhaust stack pipe led back under the root of the port wing. This arrangement was not entirely satisfactory, so the oil-cooler duct was enlarged and led forward to the nose, while twin exhaust pipes led back from the front collector ring through this fairing to eject under the belly of the fuselage. The Centaurus-powered prototype achieved a maximum speed of 402 m.p.h. at 18,000 ft., climbed to 20,000 ft. in 8.4 min., and had a service ceiling of 32,800 ft. Trials with HG641 provided valuable information for use in the development of the Centaurus-powered Tempest II.



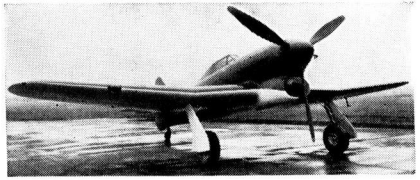
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,980 *h.p. Rolls-Royce Vulture V twenty-four-cylinder X-type liquid-cooled engine.* **Armament:** *(Proposed) Twelve* 0.303-*in. Browning machine guns or four* 20-*mm. British Hispano cannon.* **Performance:** *Maximum speed,* 398 *m.p.h. at* 23,000 *ft.; climb to* 20,000 *ft.,* 7.2 *min.; service ceiling,* 34,900 *ft.* **Weights:** *Empty,* 8,377 *lb.; loaded,* 10,668 *lb.* **Dimensions:** *Span,* 41 *ft.* 11 *in.; length,* 32 *ft.* 10 *in.; height* 14 *ft.* 8 *in.; wing area,* 283 *sq. ft.*

HAWKER TYPHOON

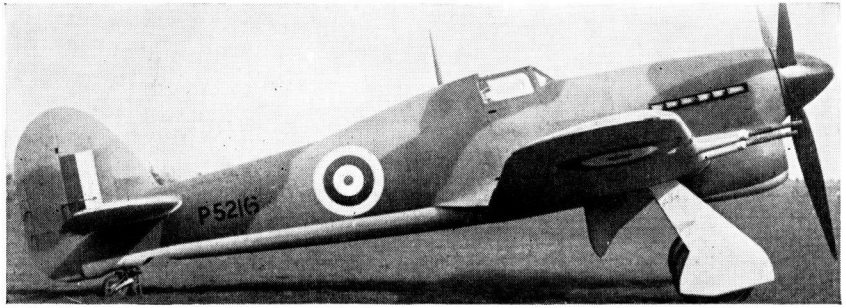
GREAT BRITAIN

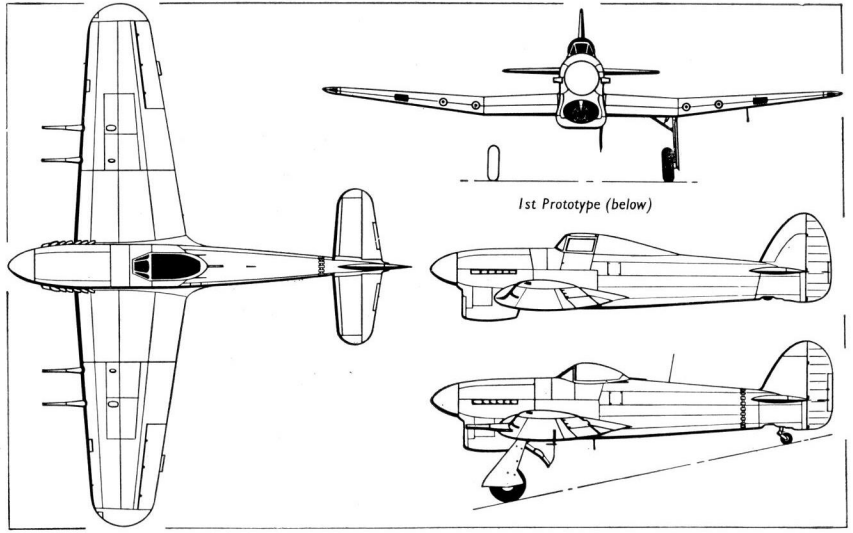
Developed in parallel with the previously described Tornado and designed to meet the requirements of the same F.18/37 specification, the Typhoon had a somewhat chequered career. It suffered a number of serious teething troubles, and the desire of the Air Staff to introduce the Typhoon into the squadrons as rapidly as possible resulted in the R.A.F. receiving an inadequately developed aircraft. The inauspicious beginnings of its service career nearly led, at one time, to the Typhoon's withdrawal from the squadrons, and as an interceptor it was undoubtedly a failure! The Typhoon was never to become a "pilot's aeroplane" but, adapted to carry bombs and rocket projectiles, it did eventually become a devastating close-support weapon which was to distinguish itself during the Battle of Normandy.

The first prototype Typhoon (P5212) made its initial flight on February 24, 1940, two prototypes having been ordered on August 30, 1938. The prototype's low-speed handling characteristics left much to be desired, and it evinced a particularly vicious swing to starboard during take-off. Severe vibration was experienced as the slipstream buffeted the thick wing roots owing to the close proximity of the Sabre engine to the wing leading edges and, on May 9, 1940, the monocoque structure aft of the cockpit failed. During the same month the Typhoon lost all development



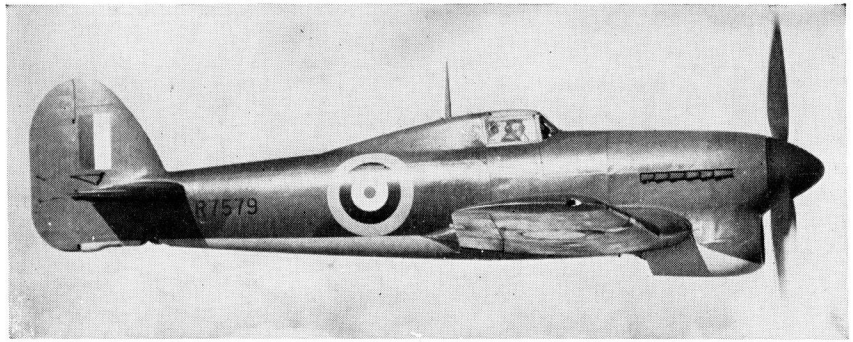
(Left) The first Typhoon (P5212) and (below) the second Typhoon prototype (P5216).

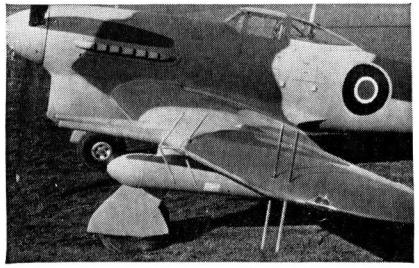




priority in order to permit concentration on Hurricane production and development, but with the reinstatement of this priority during the following October, Gloster Aircraft were awarded responsibility for the new fighter's production.

The first production machine, a Typhoon IA (R7576), flew on May 27, 1941, early production aircraft being powered, like the prototypes, by the unreliable 2,100 h.p. Sabre I engine. Armament comprised twelve wing-mounted 0.303-in. Browning machine guns with 486 rounds per gun, but the Typhoon IB had four wing-mounted 20-mm. Hispano cannon, this armament having been installed in the second prototype, P5216, and aircraft of this type were interspersed among the Mk.IAs of the first two production batches, eventually becoming the principal production model. The Sabre I engine was quickly supplanted by the improved Sabre IIA of 2,180 h.p., and this was to be progressively succeeded by the 2,200 h.p. Sabre IIB and the 2,260 h.p. Sabre IIC during the Typhoon's production life, the last-mentioned engine driving three- or four-bladed de Havilland or Rotol airscrews.





(*Above*) *The fourth production Typhoon IA* (*R*7579) *and* (*left*) *A.I.Mk.VI radar on Typhoon IB* (*R*7881).

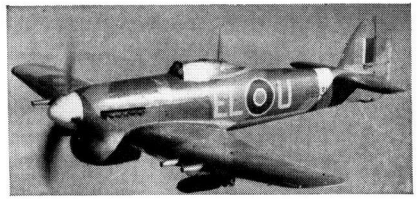
Despite the disappointing climb rate and lack of altitude performance of the new fighter, and the frequent failures suffered by its Sabre engine, the Air Staff, impressed by the Typhoon's high performance at low altitude, pressed for its rapid service introduction to counter the new Focke-Wulf Fw 190s which had begun to make low-altitude tip-and-run raids over the United Kingdom. Thus, in September 1941, Nos. 56 and 609 Squadrons based at Duxford began to re-equip with the Typhoon, these units being forced to take on the unwelcome and, as it transpired, dangerous task of discovering the fighter's many shortcomings.

In dives at speeds approaching 500 m.p.h. severe buffeting and aileron reversal were experienced, and during the first nine months of its service life, the Typhoon suffered an alarming accident rate. It enjoyed some successes, however, against low-flying Fw 190s and Me 210s, but far more Typhoons were lost through structural or engine failures than from enemy action. Between July and September 1942, it was estimated that at least one Typhoon failed to return from each sortie owing to one or other of its defects. Structural failures in the tail assembly gave most cause for alarm. During the Dieppe operations in

August 1942, when the first official mention of the Typhoon was made, fighters of this type bounced a formation of Fw 190s south of Le Treport, diving out of the sun and damaging three of the German machines, but two of the Typhoons failed to pull out of their dives owing to structural failures.

The trouble was eventually traced to a fatigue failure of the rear fuselage transport joint, no less than 135 such failures occurring, and this was finally rectified by the fitting of fishplates immediately forward of the tailplane. Troubles with the Sabre engine were progressively eradicated, and by the end of 1942 the Typhoon was being increasingly used for offensive operations, the first night intrusion by a Typhoon over France being flown on November 17, 1942, by Wing Commander Roland Beamont of No. 609 Squadron. The Typhoon was repeatedly used in the night intruder role, and one Typhoon was fitted with A.I. (Airborne Interception) Mk.VI radar late in 1941. This aircraft (R7881) was employed for night-fighting trials, but these were not attended with marked success, and no further installations of this type were made.

The Typhoons of Nos. 174, 181, 245 and 609 Squadrons enjoyed remarkable success during their offensive sweeps over France, Belgium and Holland, and the offensive power of their machines was steadily increased, the original pair of 250-lb. bombs being progressively boosted to two 500-lb. and, eventually, 1,000-lb. bombs. The Typhoon was not to find its true element, however, until it was adapted to carry rocket projectiles. By D-Day, in June 1944, the R.A.F. possessed twenty-six operational Typhoon squadrons, and during the Battle of Normandy the Typhoon decimated a large concentration of German armour ahead of Avranches, disposing of no fewer than 137 tanks, and opening the way for the liberation of France and Belgium.



A Typhoon IB of No. 181 *Squadron.*

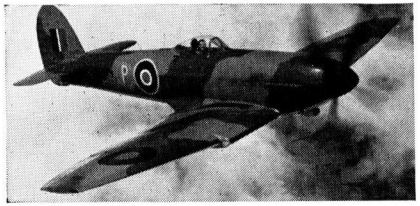
As part of their engine development programme, Napier designed an annular radiator for the Sabre, and the first such installation was made on a Typhoon IB (R8694). For use in the tactical reconnaissance role two modified versions were produced as the Typhoon F.R.IB in mid-1944, one version having two vertical cameras in the rear fuselage, and the other having a forward-facing cine recorder in place of the port inboard cannon. Production of the Typhoon terminated in 1944, a total of 3,330 machines having been delivered to the R.A.F.

Type: *Single-seat Fighter-bomber.* **Power Plant:** *One* 2,180 *h.p. Napier Sabre IIA twenty-four-cylinder horizontal-H liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano cannon with* 140 *r.p.g. and two* 1,000-*lb. bombs or eight* 60-*lb. rocket projectiles.* **Performance:** *Maximum speed,* 374 *m.p.h. at* 5,500 *ft.,* 405 *m.p.h. at* 18,000 *ft.; maximum cruising speed,* 330 *m.p.h.; range,* (*clean*) 610 *mls. at* 254 *m.p.h. at* 15,000 *ft.,* (*with maximum bomb load*) 510 *mls.,* (*with maximum external fuel*) 1,000 *mls.; time to* 15,000 *ft.,* 6.2 *min.; service ceiling,* 34,000 *ft.* **Weights:** *Empty,* 8,800 *lb.; loaded,* 11,400 *lb.* **Dimensions:** *Span,* 41 *ft.* 7 *in.; length,* 31 *ft.* 10 *in.; height, 16 ft.* 3½ *in.; wing area,* 279 *sq. ft.*

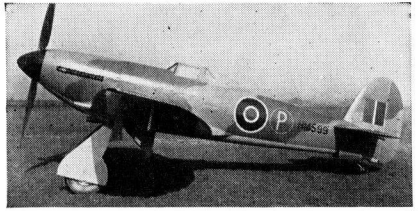
HAWKER TEMPEST I

GREAT BRITAIN

When, in 1937, design work was initiated on the Typhoon and Tornado fighters, little was known of the effects of compressibility at high speeds. An N.A.C.A.22 series aerofoil section was selected for these fighters as it offered high lift and ample stowage space for the undercarriage and the fuel. This section proved satisfactory for speeds up to some 400 m.p.h., but serious compressibility manifested itself at higher speeds. In fast dives the Typhoon and Tornado experienced sudden and sharp increases in drag which were accompanied by changes in the aerodynamic characteristics of the fighters, affecting the pitching moment and resulting in serious nose-heaviness. As early as 1940, Sydney Camm, Hawker's chief designer, began to consider the development of a thinner, high-speed aerofoil to delay the onset of compressibility and, by 1941, a considerable amount of information on the compressibility phenomena had been obtained.

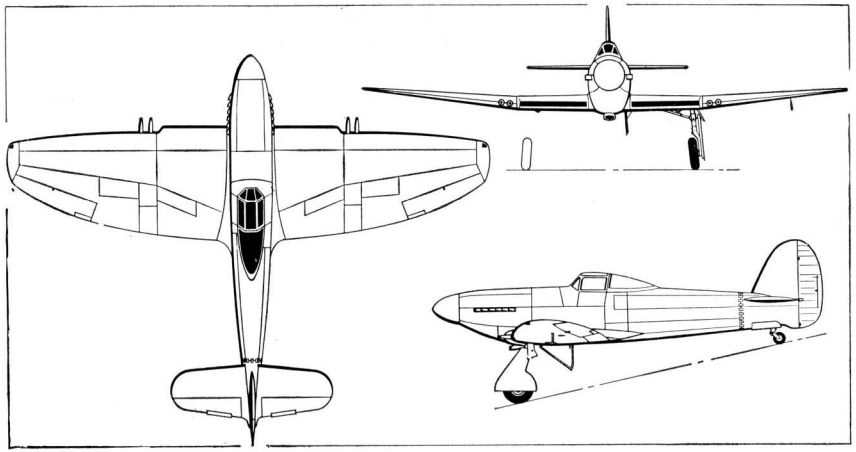


The sole prototype Tempest I, HM599.



In August 1941, Hawker Aircraft submitted proposals for a version of the Typhoon with a thinner wing, and in the following month actual design work on the new wing section commenced. It was intended to fit the modified fighter with the new Sabre IV engine rated at 2,240 h.p. at 3,850 r.p.m. and, in November 1941, two prototypes of what was then designated Typhoon II were ordered. The wing section adopted had its point of maximum thickness at 37.5 per cent chord, a thickness/chord ratio decreasing from 14.5 per cent at the root to 10 per cent at the tip, and the wing planform was semi-elliptical. The thinner wing could not house a comparable quantity of fuel to that accommodated by the original Typhoon wing and, in order to maintain the range capability of the fighter, it was found necessary to install a large fuel tank in the body of the aeroplane. To provide accommodation for this tank an extra bay had to be built into the fuselage, the overall length of which was increased by 21 in. forward of the c.g.

By the end of 1941, the Typhoon II differed so markedly from the Typhoon I that, in the following January, the name Tempest was adopted, and during the following June it was proposed that six prototypes be built: one with the Sabre IV (Tempest I), two with the Centaurus V (Tempest II), two with the Griffon IIB (Tempest III), later to be replaced by Griffon 61 power eggs (Tempest IV), and one with the Sabre II (Tempest V). Owing to Hawker Aircraft's heavy commitments at this period of the war, it was decided to proceed



with only three prototypes, representing the Tempests I, II and IV.

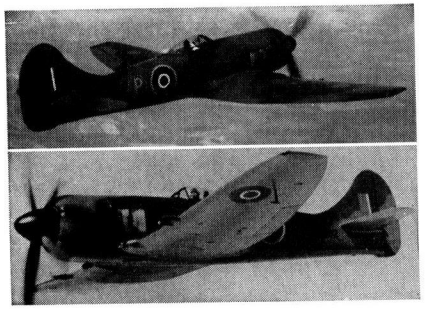
A production contract for 400 Tempest Is was placed in August 1942 but, owing to subsequent delays in the Sabre IV programme, this contract was later transferred to the Tempest V, the first prototype of which had flown on September 2, 1942. The Tempest I prototype (HM599) did not fly until February 24, 1943, and powered by the Sabre IV, it featured wing leading-edge oil cooler and radiators. The Tempest I proved to be the fastest of the Tempest series of fighters, but although flight trials were extremely promising, the Napier company did not persist with the development of the Sabre IV engine, and production plans for the Tempest I were abandoned. The prototype was eventually fitted with a Sabre V engine in February 1944, and the Sabre IV was installed in the prototype Tempest V (HM595) at one stage in its career for comparative trials. Tests with the Tempest I continued until August 1945.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 2,240 *h.p. Napier Sabre IV twenty-four-cylinder horizontal-H liquid-cooled engine.* **Armament:** (*Proposed*) *Four* 20-*mm. Hispano Mk.V cannon with* 150 *r.p.g.* **Performance:** *Maximum speed,* 466 *m.p.h. at* 24,500 *ft.* **Weights:** *Normal loaded* (*Sabre IV*), 11,050 *lb.,* (*Sabre V*), 11,180 *lb.* **Dimensions:** *Span,* 41 *ft.* 0 *in.; length,* 33 *ft.* 7 *in.; height,* 16 *ft.* 0 *in.; wing area,* 310 *sq. ft.*

HAWKER TEMPEST II

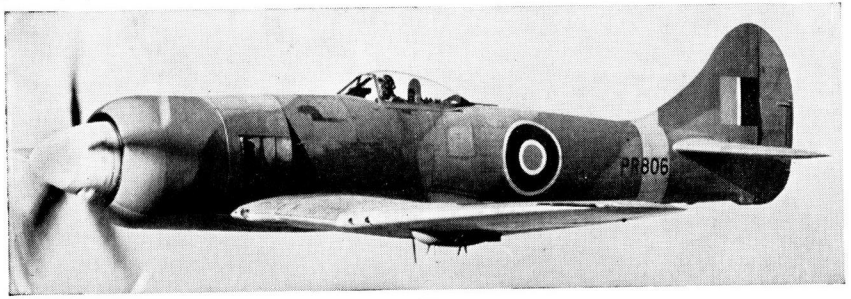
GREAT BRITAIN

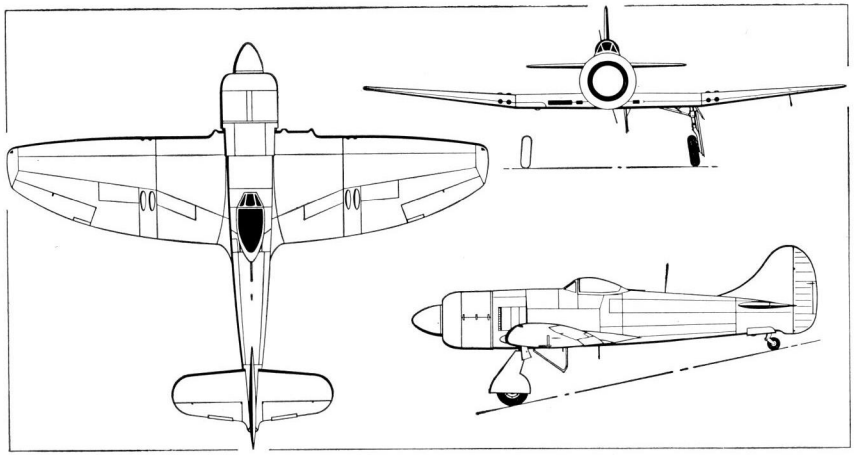
The Tempest II, destined to serve with the R.A.F. as that service's last single-seat single-piston-engined fighter-bomber, was developed in parallel with the Tempests I and V, and owed much to experience gained with the Centaurus-powered Tornado prototype (HG641). Owing to the longer fuselage of the Tempest than that of the Typhoon, it was seen at an early stage in the later fighter's development that the Centaurus radial air-cooled engine could at last be installed in a standard Hawker airframe without extensive structural changes.



The first Tempest II prototype (LA602) flew initially on June 28, 1943, being followed on September 18, 1943, by a second prototype (LA607), but production priority was given to the Tempest V, and deliveries of the Tempest II did not commence until October 1944. The Tempest II, the most powerful fighter powered by a single piston engine to see service with the R.A.F., was intended primarily for operations with Tiger Force against the Japanese in the Far East where its excellent range would undoubtedly have proved most useful. It was proposed that a Wing of fifty Tempest IIs be sent to the Pacific in May 1945, but in the event, hostilities terminated before the fighter had been issued to the squadrons, the first squadron to re-equip with the Tempest II being No. 54 Squadron at Chilbolton which received the new aircraft in November 1945.

(Above, left) The first Tempest II prototype (LA602) and (below) a production Mk.II (PR806).



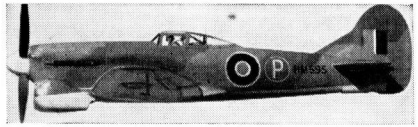


Part of the production contract for the Tempest IIs was allocated to the Bristol Aeroplane Company's Weston-super-Mare factory which was to have built fifty machines, the first of which (MW374) flew for the first time on October 4, 1944. In fact, only the first thirty-six Tempest IIs were built by Bristol, the remaining fourteen of the initial order being transferred to Hawker Aircraft who had built a further four hundred machines when production terminated in May 1946.

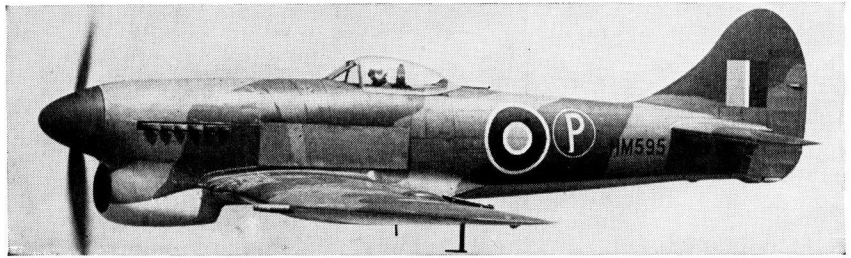
Type: *Single-seat Interceptor and Fighter-bomber.* **Power Plant:** *One* 2,520 *h.p. Bristol Centaurus V or VI eighteen-cylinder air-cooled radial engine.* **Armament:** *Four* 20-*mm. Hispano Mk.V cannon with* 150 *r.p.g. plus two* 1,000-*lb. bombs or eight* 60-*lb. rocket projectiles.* **Performance:** *Maximum speed,* 440 *m.p.h. at* 15,900 *ft.,* 417 *m.p.h. at* 5,000 *ft.; maximum cruising speed,* 422 *m.p.h. at* 15,500 *ft.; range, (internal fuel),* 775 *mls. at* 210 *m.p.h. at* 5,000 *ft., (with maximum external fuel)* 1,700 *mls.; initial climb rate,* 4,520 *ft./min.; time to* 10,000 *ft.,* 2.5 *min.; to* 20,000 *ft.,* 5.6 *min.; service ceiling,* 37,000 *ft.* **Weights:** *Empty,* 9,300 *lb.; loaded,* 11,800 *lb.; maximum,* 13,900 *lb.* **Dimensions:** *Span,* 41 *ft.* 0 *in.; length,* 34 *ft.* 5 *in.; height,* 15 *ft.* 6 *in.; wing area,* 303.7 *sq. ft.*

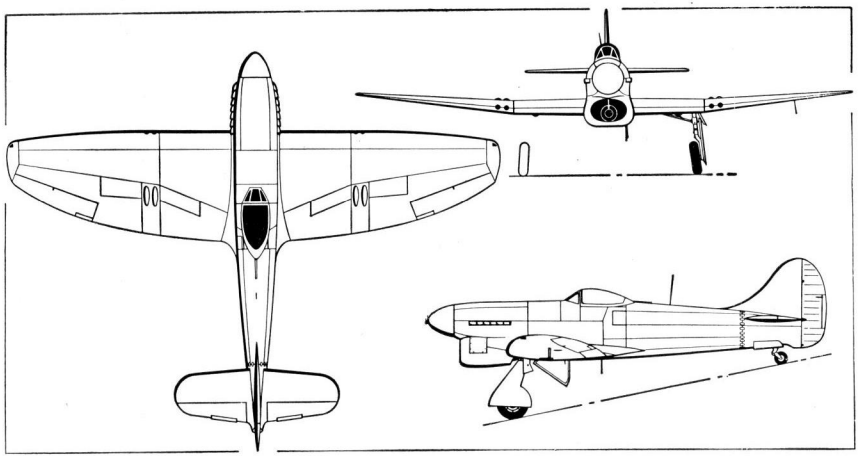
The Tempest V preceded the Tempest II into production and squadron service, and was, in fact, the only variant of the Tempest series of fighters to be employed operationally during the Second World War. Meeting the requirements of specification F.10/41, the Tempest V employed the well-tried Sabre II engine of the Typhoon yet, despite its close family resemblance to the earlier fighter and the use of the same engine, it possessed a markedly superior performance, being an object lesson in aerodynamic refinement. A production contract for the Tempest V was awarded in February 1942, more than six months before the maiden flight of the first prototype. This aircraft (HM595), which served successively as prototype for both the Tempest V and the later Tempest VI, was a conversion of a Typhoon airframe, flying in its new form for the first time on September 2, 1942.

The first production Tempest V (JN729) flew on June 21, 1943, and the type entered service in April 1944 with Nos. 3 and 486 Squadrons, No. 56 Squadron also re-equipping with the Tempest during the following July. Within a couple of months of their formation these squadrons, possessing the fastest low-medium altitude fighters available to the R.A.F., had become the mainstay of Britain's fighter defence against German flying bombs, destroying no fewer than 638 of the 1,771 missiles destroyed by the R.A.F. between June 13 and September 5, 1944. Two days after D-Day, Tempest Vs met enemy aircraft in combat for the first time, destroying three Bf 109G fighters without loss to themselves, but its service introduction had not proceeded entirely smoothly.



(Above, left) The prototype Tempest V (HM595) with original hood and (below) with bubble canopy.

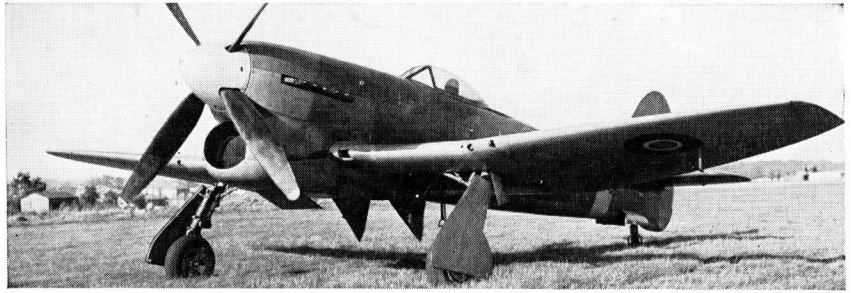




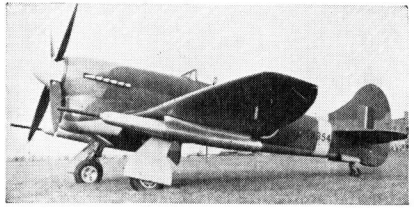
By May 1944, five Tempest Vs had been lost as the result of engine failures. The trouble was traced to over-speeding of the airscrew which resulted in an uncontrollable increase in engine revolutions, the failure of the bearings and the collapse of the oil system. In June, the problem was solved by the fitting of modified airscrews, and subsequently the fighter established a splendid reputation.

The first hundred production aircraft were designated Tempest V Series 1, these having Hispano Mk.II cannon which projected slightly ahead of the wing leading edges and non-detachable rear fuselages. Production continued with the Tempest V Series 2, a total of 705 examples of which was delivered. This series had the short-barrelled Mk.V cannon which did not project, a detachable rear fuselage, small diameter wheels, and spring tabs on one aileron and the rudder. Early Tempest Vs had the 2,180 h.p. Sabre IIA engine, but this was supplanted on the production line by the 2,200 h.p. Sabre IIB and, later, by the 2,260 h.p. Sabre IIC. One Tempest V (SN354) was experimentally fitted with two 40-mm. cannon underwing, and another (NV768) was used by the Napier company as part of their engine development programme, being fitted with several types of annular radiator and ducted spinner.

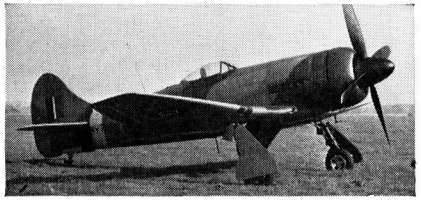
A further development, the Tempest VI powered by the 2,340 h.p. Sabre VA engine, flew on May 9, 1944, the prototype (HM595) being the original Tempest V prototype. Externally, the Tempest VI differed from the Mk.V only in having intake ducts for the oil



(*Above*) *Tempest VI* (*NV*778) *and* (*immediately below*) *Tempest V* (*SN*354) *with* 40-*mm.cannon.*



(*Below*) *Tempest V* (*NV*768) *with annular radiator.*

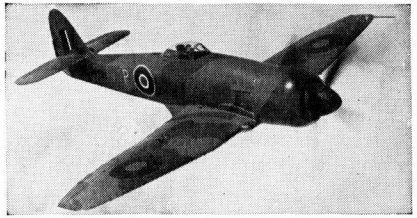


cooler in the starboard wing root and for the carburettor in both wings, these being transferred from the nose owing to the larger radiator frontal area required by the Sabre VA. The Tempest VI was too late to see operational service, but 142 were delivered.

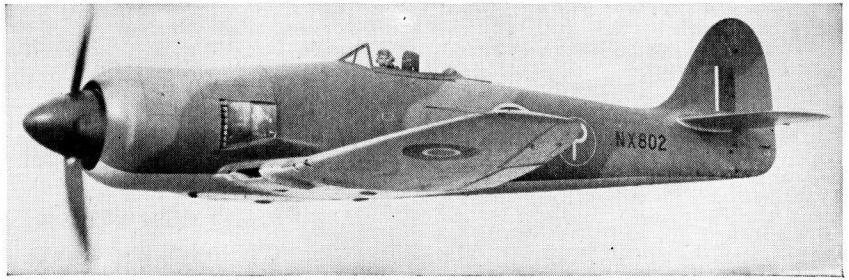
The following specification relates to the Tempest V Series 2.

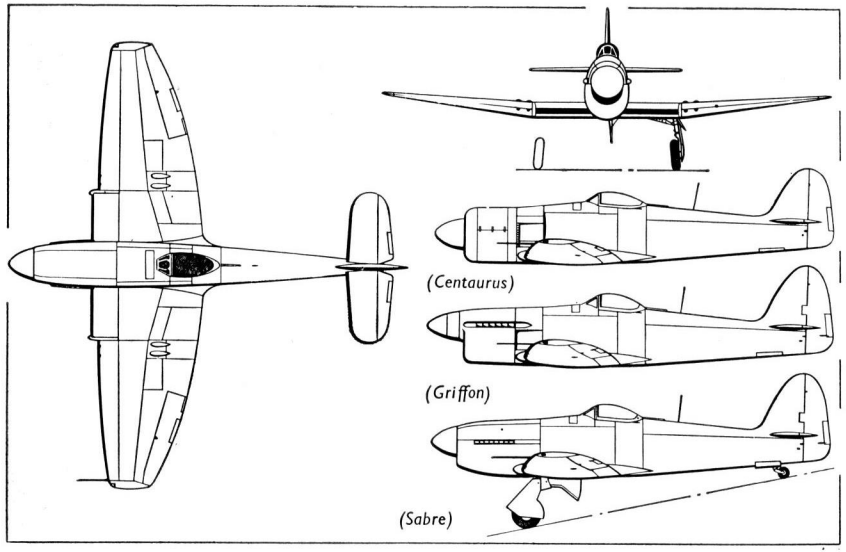
Type: *Single-seat Low- and Medium-altitude Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 2,200 *h.p. Napier Sabre IIB twenty-four-cylinder horizontal-H liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano Mk.V cannon with* 150 *r.p.g., and two* 1,000-*lb. bombs or eight* 60-*lb. rocket projectiles.* **Performance:** *Maximum speed,* 392 *m.p.h. at sea level,* 416 *m.p.h. at* 4,600 *ft.,* 435 *m.p.h. at* 17,000 *ft; maximum cruising speed,* 391 *m.p.h. at* 18,800 *ft.; range,* (*clean*) 820 *mls. at* 210 *m.p.h. at* 5,000 *ft.,* (*with two* 45 *imp. gal. drop tanks*)1,300 *mls.; initial climb rate,* 4,700 *ft./min.; time to* 10,000 *ft.,* 2.7 *min., to* 20,000 *ft.,* 6.1 *min.; service ceiling,* 36,000 *ft.* **Weights:** *Empty,* 9,250 *lb.; loaded,* 11,400 *lb.; maximum,* 13,500 *lb.* **Dimensions:** *Span,* 41 *ft.* 0 *in.; length,* 33 *ft.* 8 *in.; height,* 16 *ft.* 1 *in.; wing area,* 302 *sq. ft.*

The fortuitous presentation of a Focke-Wulf 190A-3 to the R.A.F. on June 23, 1942—the pilot, Oberleutnant Arnim Faber having mistaken R.A.F. Pembrey for a Luftwaffe Channel coast airfield—had a profound influence on fighter-design thinking in the United Kingdom. Its arrival was largely responsible for the preparation of specification F.6/42, to meet the requirements of which Hawker evolved a project known as the "Tempest Light Fighter (Centaurus)". During 1941 the Hawker design team had considered several proposals for light fighters intended to reverse the upward weight spiral, including the Sabre IV-powered P.1018, the Griffon 61-powered P.1019, and the Centaurus IV-powered P.1020, but these remained design studies, and late in 1942 the first discussions were held concerning the possibility of a smaller and lighter version of the Tempest in which the existing wing centre section would be eliminated. In January 1943 it was decided that this development should conform to specification F.6/42, but within two months a new specification, F.2/43, had been drawn up around the project, and in April 1943 the issue of naval interceptor specification N.7/43 prompted Sydney Camm to suggest that, with an up-rated Centaurus XII engine, the same design could meet the requirements of both specifications. Thus the requirements were pooled, Hawker taking responsibility for the development and construction of the land-based fighter and Boulton



(*Above, right*) *The first Fury prototype* (*NX*798) *and* (*below*) *the third Fury prototype* (*NX*802).





Paul accepting the task of adapting the aircraft for shipboard operations.

Apart from its smaller overall dimensions, the new fighter was distinguished from the Tempest in having a fuselage of monocoque construction throughout. The same high-speed aerofoil section was employed, and the wing consisted of two Tempest outer sections bolted together on the fuselage centre-line. Several alternative engines to the Centaurus XII were considered, and by December 1943 six prototypes had been ordered, two of these being powered by the Griffon, two by the Centaurus XXII, and one by the Centaurus XII, the remaining prototype being a test structure. Early in the following year, a revised specification, N.22/43, supplanted N.7/43, and in April 1944 contracts were placed for 200 F.2/43 fighters for the R.A.F. and 200 N.22/43 fighters for the Navy, 100 of the latter being awarded to Boulton Paul.

Shortly after the Centaurus-powered first prototype of the land-based variant (NX798) had flown on September 1, 1944, the names Fury and Sea Fury were officially adopted for the R.A.F. and F.A.A. versions. The second

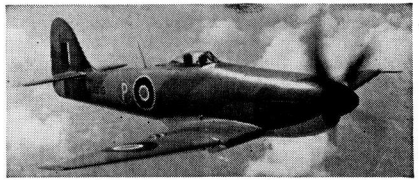
prototype Fury (LA610) flew on November 27, 1944 with a Rolls-Royce Griffon 85 driving Rotol three-blade contra-rotating airscrews, but this power plant was quickly replaced by a Centaurus XV with which the aircraft was flying in February 1945, and subsequently by the Napier Sabre VII with which it flew in May 1945. It was proposed that the production Fury I should be powered by the Sabre VII with which the second Fury prototype attained 485 m.p.h. at 18,500 ft. However, the third Fury prototype (NX802) flew on July 25, 1945 with a Centaurus XV engine.

With the termination of hostilities, the R.A.F., by now committed to a jet programme, cancelled all production contracts for the Fury, although, after the war, the fighter was built in small numbers for Iraq, Egypt, and Pakistan (the first and third prototypes were sold to Egypt and Pakistan respectively), and a new prototype (LA610) with a Sabre VII was completed from stock parts and flown in 1947.

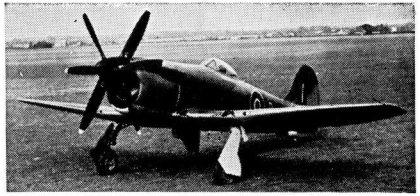
The first Sea Fury prototype (SR661), a semi-navalised machine, was flown on February 21, 1945 with a Centaurus XII, and a fully navalised second prototype (SR666) flew after the war, on October 12, 1945. Although in January 1945 Sea Fury production contracts were cut back to 100 aircraft, the Boulton Paul contract being completely cancelled, production continued in the post-war years, the aircraft becoming standard shipboard equipment.

The following specification relates to the Sabre VII-powered Fury, figures in parentheses relating to the Centaurus XV-powered Fury.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 3,055 (2,400) *h.p. Napier Sabre VII* (*Bristol Centaurus XV*) *twenty-four-cylinder liquid-cooled horizontal H* (*eighteen-cylinder radial air-cooled*) *engine.* **Armament:** *Four* 20-*mm. Hispano Mk. V cannon with* 145 *r.p.g. plus eight* 60-*lb. rockets or* 2,000-*lb. bomb load.* **Performance:** *Maximum speed,* 485 (455) *m.p.h. at* 18,500 (24,000) *ft.,* 457 (435) *m.p.h. at* 8,000 (36,000) *ft.*; *range* (*with two* 45 *Imp. gal. drop tanks*), 1,480 *mls.*; *initial climb rate,* 5,240 (4,300) *ft./min.*; *time to* 8,000 (10,000) *ft.,* 1.7 (3) *min., to* 24,000 (20,000) *ft.,* 6 (5.5) *min.*; *service ceiling,* 41,500 (43,500) *ft.* **Weights:** *Empty,* 9,350 (8,615) *lb.*; *loaded,* 12,120 (11,675) *lb.* **Dimensions:** *Span,* 38 *ft.* 4¾ *in.*; *length,* 34 *ft.* 8 *in.* (34 *ft.* 7 *in.*); *height,* 14 *ft.* 7½ *in.*; *wing area,* 284.5 *sq. ft.*



The second prototype Fury, LA610, with Sabre VII.



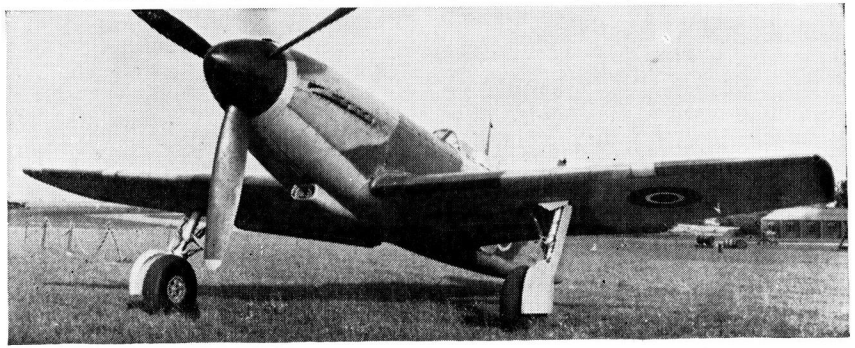
The second prototype Fury with a Griffon 85 driving Rotol three-blade contra-rotating airscrews.

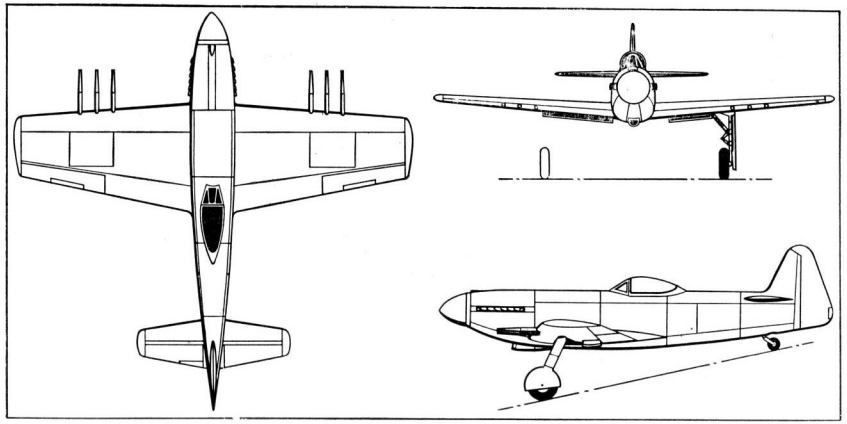
MARTIN-BAKER M.B.3 GREAT BRITAIN

The M.B.3 single-seat fighter was designed by James Martin of the Martin-Baker Aircraft Company to meet the requirements of specification F.18/39. This specification called for a maximum speed of not less than 400 m.p.h. at 15.000 feet, a service ceiling of not less than 35,000 feet, a fuel capacity sufficient for thirty minutes at maximum power, two hours at economical cruising power plus thirty per cent reserves, and a loaded weight not exceeding 12.000 lb. Dominating the design were the precepts of structural simplicity and sturdiness combined with good handling qualities, and considerable attention was given to the problems of servicing and rearming. The fuselage employed a steel-tube structure enclosed by large detachable metal panels, and the wing, of torsion box construction about a laminated steel spar, was a remarkably strong and stiff structure. The phenomenally heavy armament of six 20-mm. cannon was installed, their installation being particularly good operationally, a quick turn-round being ensured by the extreme accessibility of the gun and ammunition bays. The underwing coolant and oil radiators for the Sabre II horizontal-H engine possessed extremely low frontal areas.

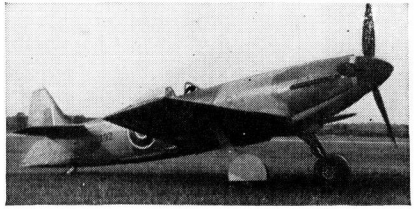
Two prototypes of the M.B.3 were ordered, and the first of these (R2492) was flown for the first time on August 31, 1942 with Captain V. H. Baker at the controls, the cannon armament being first removed. In its original form, the M.B.3's cockpit was faired to the vertical tail surfaces, but after initial trials an all-round-vision "bubble" type canopy was adopted. Trials indicated that the prototype was extremely manoeuvrable and possessed excellent handling characteristics, but on September 12, 1942, during a landing approach, the Sabre engine failed and the aircraft burst into flames after hitting a haystack, the aircraft being completely destroyed.

The Martin-Baker M.B.3 with armament removed and original faired cockpit canopy.





Construction of the second prototype had been delayed pending flight experience with the first machine. Initially, it was proposed to install a Rolls-Royce Griffon engine in the second prototype which was to have received the designation M.B.4, but this scheme was abandoned in favour of an extensively redesigned model, the M.B.5, which retained little more than the wings and undercarriage of the original fighter.



Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 2,020 *h.p. Napier Sabre II twenty-four-cylinder horizontal-H type liquid-cooled engine.* **Armament:** *Six* 20-*mm. British Hispano cannon with* 200 *r.p.g.* **Performance:** *Maximum speed,* 415 *m.p.h. at* 20,000 *ft.,* 372 *m.p.h. at sea level; maximum cruising speed,* 370 *m.p.h. at* 15,000 *ft.; initial climb rate,* 4,350 *ft./min.; service ceiling,* 36,000 *ft.* **Weights:** *Loaded,* 11,497 *lb.* **Dimensions:** *Span,* 35 *ft.* 0 *in.; length,* 35 *ft.* 4 *in.; height,* 15 *ft.* 6¾ *in.; wing area,* 262.64 *sq. ft.*

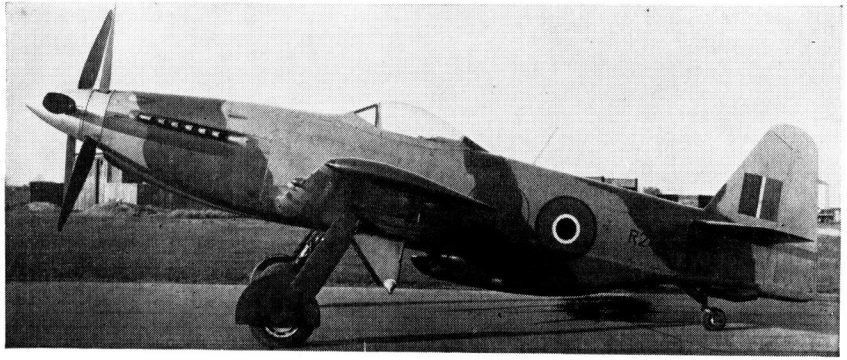
MARTIN-BAKER M.B.5

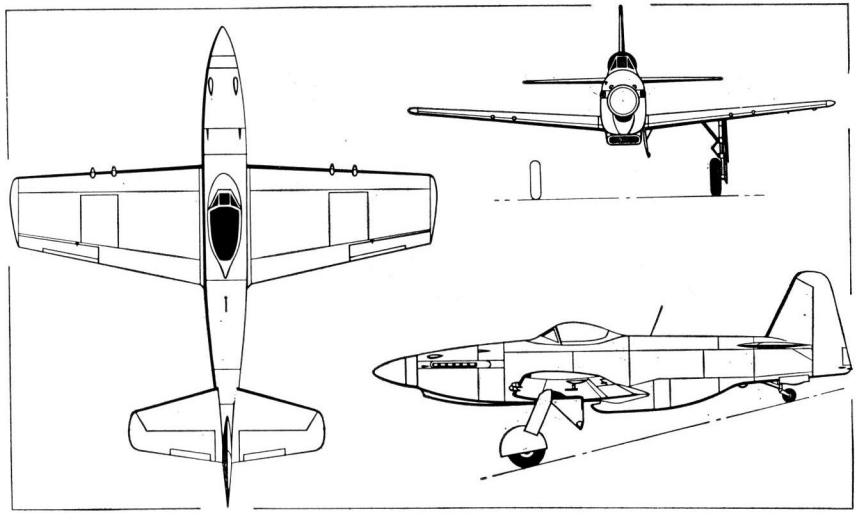
GREAT BRITAIN

The M.B.5 was considered by many to represent the extreme limit of piston-engined fighter development; a milestone marking the end of an era. There is no doubt that when, on May 23, 1944, the M.B.5 (R2496) was flown for the first time with L. Bryan Greensted at the controls, this fighter was in many ways ahead of its time. Apart from its superlative performance and handling characteristics, the M.B.5 had a number of outstanding qualities, and the official report of the Armament and Experimental Establishment stated that "the general design and layout of the M.B.5 is excellent and is infinitely better—from the engineering and maintenance aspects—than any other similar type of aircraft. It is further considered that the layout of the cockpit might very well be made a standard for normal piston-engined fighters, and that the engine installation might be applied advantageously to other aircraft".

The M.B.5 began life as the second of the two M.B.3 prototypes ordered to specification F.18/39 and which, at the time of the first prototype's destruction, was in an early stage of construction. The wings of the M.B.5 were essentially similar to those of the ill-fated M.B.3, and the fuselage primary structure was of steel tube construction, simple, sturdy and economical in weight, covered and faired with detachable light metal panels which offered exceptional accessibility. The Griffon 83 drove a six-blade contra-rotating airscrew, and the four-cannon installation, which utilised Martin Patent Flat Belt Feed Mechanisms, was exceptionally well arranged.

The Martin-Baker M.B.5 was considered by many the best all-round fighter evolved during World War II.

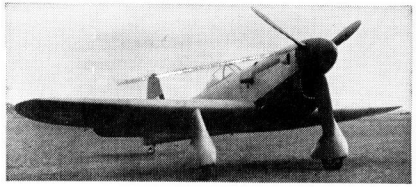




All pilots who flew the M.B.5 were fulsome in their praise of its qualities, and why this aircraft was not put into production remains one of the minor mysteries of the war for, had an early decision been reached by the authorities, it could have reached the squadrons in time to see operational service. It was perhaps the best all-round fighter evolved during the war years, and much might have been learned from the M.B.5 had it been placed in production and service.

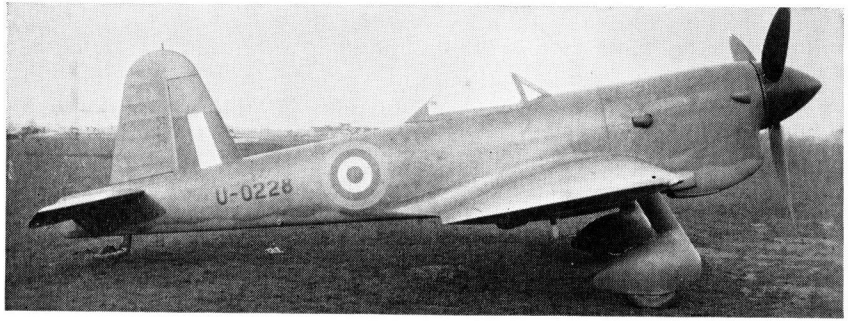
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 2,340 *h.p. Rolls-Royce Griffon* 83 *twelve-cylinder V-type liquid-cooled engine.* **Armament:** *Four* 20-*mm. British Hispano Mk.II cannon with* 200 *r.p.g.* **Performance:** *Maximum speed,* 395 *m.p.h. at sea level,* 425 *m.p.h. at* 6,000 *ft.,* 460 *m.p.h. at* 20,000 *ft.; normal cruising speed,* 320 *m.p.h. at* 10,000 *ft.,* 360 *m.p.h. at* 20,000 *ft.; range,* 1,100 *mls. at* 250 *m.p.h. at* 20,000 *ft.,* 950 *mls.* at 325 *m.p.h. at* 20,000 *ft.; initial climb rate,* 3,800 *ft./min.; climb at* 7,000 *ft.,* 4,000 *ft./min.; time to* 20,000 *ft.,* 6.5 *min., to* 34,000 *ft.,* 15 *min.; service ceiling,* 40,000 *ft.* **Weights:** *Empty,* 9,233 *lb.; normal loaded,* 11,000 *lb.; maximum,* 12,090 *lb.* **Dimensions:** *Span.* 35 *ft.* 0 *in.; length,* 37 *ft.* 9 *in.; height,* 15 *ft.* 0 *in.; wing area,* 262.64 *sq. ft.*

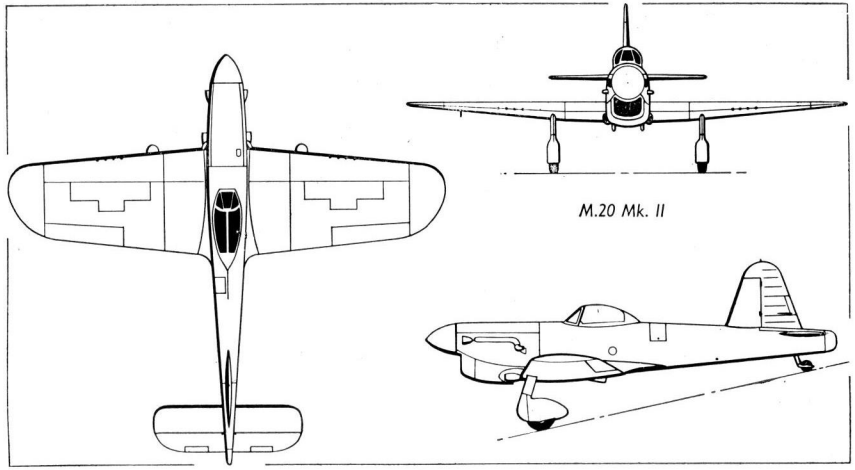
A few weeks before the commencement of the "Battle of Britain" it became evident that the supply of aircraft to R.A.F. Fighter Command might well become critical in the months ahead, and Phillips and Powis Aircraft conceived the idea of designing a utility fighter which, without forfeiting performance, could be produced rapidly in large numbers. Lord Beaverbrook, at that time Minister of Aircraft Production, was approached by the company and gave instant authority to proceed with the project. On September 14, 1940, nine weeks and two days after the authority to proceed was given, the first prototype M.20 (AX834) was flown!



Designed by F. G. Miles, the M.20 sacrificed everything for speed of production. Hydraulics were eliminated, a fixed undercarriage was adopted, and standard Master advanced trainer components were employed wherever possible. The airframe comprised a two-spar wooden wing with plywood and fabric covering, a wooden semi-monocoque fuselage, and a fabric- and ply-covered wooden tail unit. The power plant was a standard Merlin XX power-egg, interchangeable with those used in the Beaufighter II, and hinged panels on the upper surfaces of the wing provided access to the gun armament, facilitating rearming. The "bubble" type all-round vision cockpit canopy was one of the first of its kind.

(Above, left) The M.20 Mk.I (AX834) and (below) the shipboard M.20 Mk.II.





Specification F.19/40 was written around the M.20 fighter which, despite its wooden construction and fixed undercarriage, was appreciably faster than the Hurricane and only slightly slower than the Spitfire, and it carried considerably more ammunition and had a greater range than either of them. In the event, no shortage of Hurricanes and Spitfires arose, and the M.20 never attained production. However, to meet the requirements of specification N.1/41, a second prototype was built as a private venture under the designation M.20 Mk.II. This was a single-seat shipboard fighter with redesigned undercarriage fairings and provision for arrester hook and catapult spools. The M.20 Mk.II was completed in April 1941, but no further development was undertaken.

Type: *Single-seat Medium and High-altitude Day Fighter.* **Power Plant:** *One* 1,460 *h.p. Rolls-Royce Merlin XX twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Eight* 0.303-*in. Browning Mk.II machine guns with* 625 *r.p.g.* **Performance:** *Maximum speed,* 345 *m.p.h. at* 20,400 *ft.,* 295 *m.p.h. at sea level; normal cruising speed,* 210 *m.p.h. at* 20,000 *ft.; maximum range,* 1,200 *mls. at* 210 *m.p.h.* **Weights:** *Empty,* 5,884 *lb.; normal loaded,* 7,800 *lb.; maximum,* 8,000 *lb.* **Dimensions** *Span,* 34 *ft.* 7 *in.; length,* 30 *ft.* 8 *in.; height,* 12 *ft.* 3 *in.; wing area,* 235 *sq. ft.*

SUPERMARINE SPITFIRE I, II AND III — GREAT BRITAIN

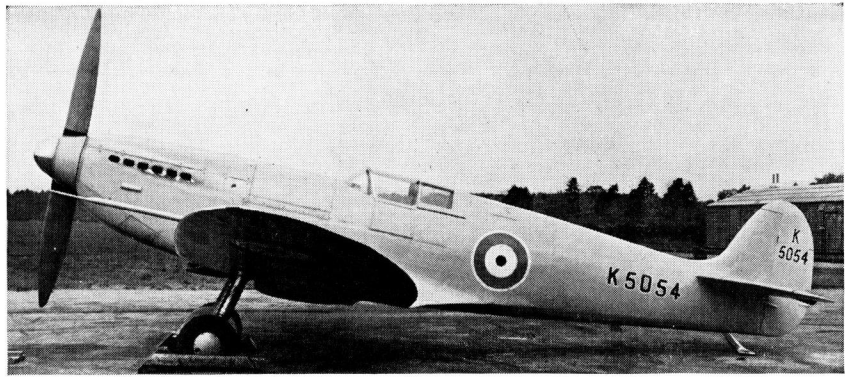
As originally conceived by Reginald J. Mitchell, the Supermarine Type 300 single-seat fighter, later to gain immortality as the Spitfire, was, in essence, the smallest and simplest warplane that could be evolved around the Rolls-Royce PV-12 engine and a battery of eight machine guns. It went far beyond specification F.5/34—the first official British fighter specification to demand an eight-gun armament, an enclosed cockpit and a retractable undercarriage—and, accepted by the Air Ministry for prototype construction in January 1935 to specification F.37/34, was an epitome of grace and design cleanliness.

Of straightforward construction with a light alloy monocoque fuselage, a single-spar stressed-skin wing, and fabric-covered control surfaces, the prototype (K5054) was flown on March 5, 1936, powered by a 990 h.p. Merlin "C"—this name having been adopted for Rolls-Royce's PV-12 engine. Displaying superlative characteristics from the commencement of its test programme, the prototype had soon reached a speed of 349.5 m.p.h. and, in the meantime, specification F.16/36 had been drawn up to cover the further development and production of the fighter. Within two months of the prototype's maiden flight, on June 3, 1936, a contract for 310 Spitfire Is had been awarded to Supermarine, this being supplemented by a contract for a further 200 machines in the following year.

Unexpected difficulties led to some delays in production deliveries which did not commence until May 1938. The first unit to re-equip with the new fighter, No. 19 Squadron at Duxford, received its first Spitfire on August 4, 1938, and had still received only five machines by mid-September. By the beginning of 1939, however, delivery tempo was increasing rapidly, and at the commencement of W. W. II nine squadrons of the R.A.F. and Aux.A.F.—Nos. 19, 41, 54, 65, 66, 72, 74, 602 and 611—were fully equipped with Spitfires. and two more Auxiliary squadrons, Nos. 603 and 609, were in process of conversion. By this time, the Spitfire had already undergone some of the development for which its amenability was to become legendary, and no fewer than 2,160 Spitfires had by now been ordered.

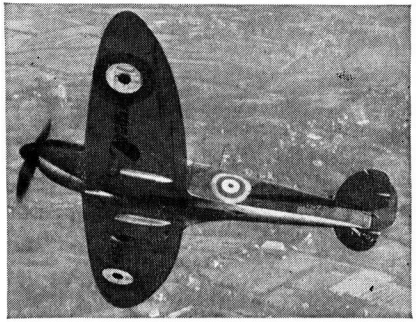
The initial production Spitfire Is employed a de Havilland two-blade fixed-pitch wooden airscrew similar to that of the prototype. No bullet-proof windscreen or armouring were fitted and, owing to a shortage of Browning guns, these early aircraft carried only four machine guns. A fixed tailwheel had supplanted the skid of the prototype, and triple ejector exhausts had replaced the flush exhausts. A Merlin II rated at 1,030 h.p. at 16,250 ft. was installed, and the two-blade airscrew soon gave place to a de Havilland three-blade two-position unit which boosted maximum speed by five m.p.h. A new domed cockpit canopy was introduced at an early production stage, and an external bullet-proof windscreen made its appearance.

Standard armament in what was subsequently to become known as the "A" wing was four 0.303-in. Brownings with 300 r.p.g., and with this battery of eight guns the fighter was designated Spitfire IA. The suffix "A" was rendered necessary by the development of a wing containing an alternative armament. Although the Browning gun armament was good, there was no doubt that the 20-mm. cannon offered superior hitting power, and late in 1938 some wing redesign was initiated to enable it to accommodate a 20-mm. cannon with sixty shells in a drum-type magazine in place of two of the Brownings. Known as the "B" wing, it was tested on an early production



The original Spitfire prototype (K5054) in its original grey finish (above) and brought up to Mk.I standards (below, right). This prototype first flew on March 5, 1936, and the first of 1,566 Spitfire Is (K9787) flew on May 14, 1938.

Spitfire I in February 1939, this aircraft becoming the prototype for the Spitfire IB, thirty examples of which had been delivered for operational trials by August 1940, but in service they were disliked by the squadrons and eventually withdrawn, the drum feed proving inadequate and causing the cannon to jam after firing a few rounds. Incidentally, a Dornier Do 17 fell to the Hispanos of an experimental cannon-armed Spitfire as early as March 1940. One further change was the adoption of Merlin III in place of Merlin II. This power plant, having a similar output to its predecessor's, had a standardised shaft for de Havilland or Rotol three-blade constant-speed airscrews. Production of the Spitfire I totalled 1,566, including 50 by Westland.



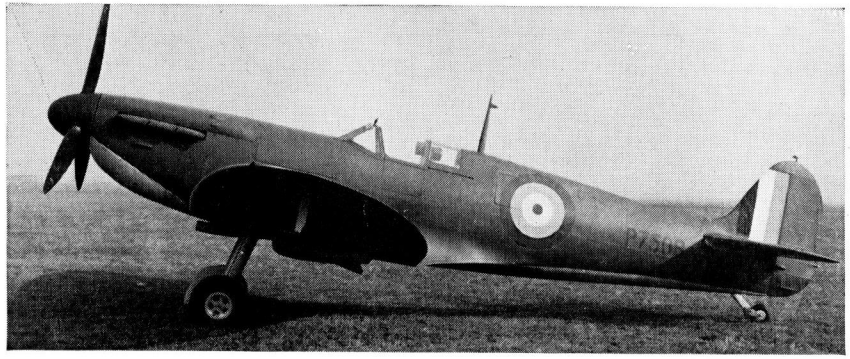
When the "Battle of Britain" began on August 12, 1940, there were nineteen Spitfire

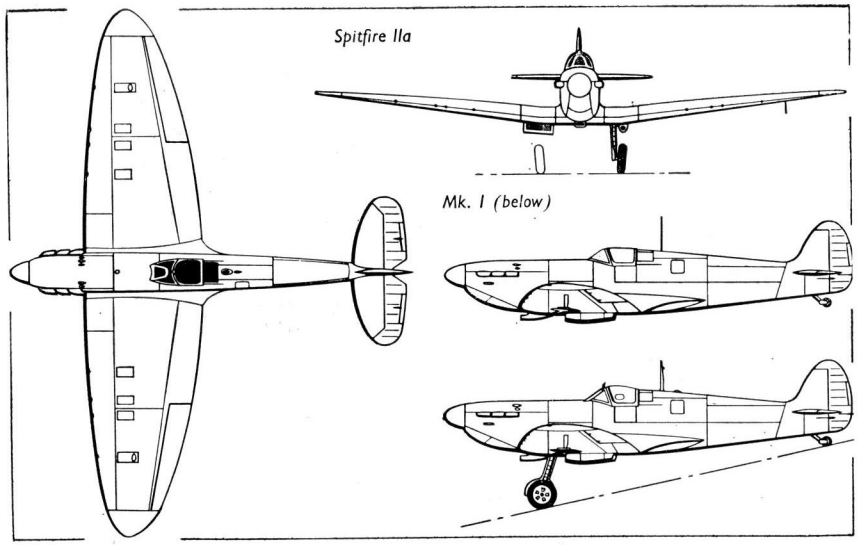
I squadrons in the R.A.F.'s order of battle. By comparison with its principal opponent, the Messerschmitt Bf 109E, the Spitfire I was marginally faster and appreciably more manoeuvrable, but the German fighter had longer-ranging armament, could outclimb and outdive its British adversary, and enjoyed altitude superiority. During the "Battle", a new version of the Spitfire incorporating the first results of operational experience began to reach the squadrons. This, the Type 329 Spitfire II, adopted the Merlin XII engine rated at 1,175 h.p. for take-off and 1,150 h.p. at 14,500 ft., and driving a Rotol three-blade Jablo constant-speed airscrew. Armour protection was provided behind the pilot's seat and head, together with forward protection for the glycol header tank and the top fuel tanks, totalling 73 lb. in weight.

Few Spitfire IIs were flying operationally during the "Battle", and its service introduction did not begin in earnest until the winter, the type being employed by Fighter Command from December 1940 for its offensive sweeps over Occupied Europe. A total of 920 Spitfire IIs followed the Mk.Is, and of these 170 were completed as Mk.IIBs with two 20-mm. Hispanos and four 0.303-in. Brownings. The Hispanos were belt fed and turned on their sides, introducing the characteristic wing blister. A number of Spitfire IIs were later converted to Mk.V standard by the installation of increased armour and a Merlin 45 Series two-stage engine.

The Spitfire was, of course, designed originally as a short-range interceptor for operation from home bases, and its fuel capacity of 85 Imp. gal. only allowed for take-off, climb to altitude, 1.65 hours' cruising and fifteen minutes combat. In a quest for greater range, a number of experiments were conducted with the Spitfire II. One machine carried a flush-fitting

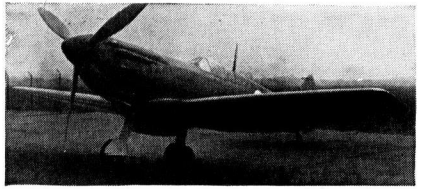
A Castle-Bromwich-built Spitfire II (P7508) photographed in October 1940.





auxiliary tank beneath each wing outboard of the wheel well, and an enlarged oil tank which deepened the nose cowling contours, and during 1941, three units—Nos. 66, 118, and 152 Squadrons—flew Spitfire IIAs with a 40 Imp. gal. long-range tank under the starboard wing. The standard auxiliary tank eventually adopted was, however, of "slipper" type fitting flush under the fuselage centre section. This was manufactured in 30, 45, and 90 Imp. gal. capacity versions. During the Norwegian campaign Supermarine were asked to convert a Spitfire to a seaplane to permit operation from sheltered waters. A Spitfire I was used, and, in order to save time, was fitted with a pair of Blackburn Roc floats. These did not lend themselves particularly well to adaptation. Nevertheless, work proceeded until the termination of the Norwegian campaign when the aircraft was reconverted to standard, no flight trials with the Type 342 floatplane, as it was designated, being undertaken.

While production had concentrated on the Spitfires I and II, work had been progressing on two further variants, the Mk.III (Types 330 and 348) and the Mk.IV (Type 337), and



(Above) The sole Spitfire III (N3297) in original form and (below) the Mk.IV (DP845) with six-cannon mock-up.

although neither was to achieve production status, they provided valuable information for subsequent variants. The Spitfire III was a refined and structurally strengthened model intended to make use of the Merlin XX engine rated at 1,280 h.p. for take-off and 1,480 h.p. at 12,250 ft. Additional armour was provided, an internal bullet-proof windscreen was introduced, the undercarriage was strengthened, and the tail-wheel was made retractable. To improve low-level performance the wingtips were removed, reducing span and area to 30 ft. 6 in. and 220 sq. ft. respectively, and the prototype (N3297) was a converted Mk.I from the second Supermarine production contract and appeared late in 1939. It later reverted to the normal full-span wing and was the first Spitfire to be fitted with the universal or "C" wing which could accommodate two Hispano cannon, one cannon and two machine guns, or four machine guns. A contract was placed with the Nuffield Group's Castle Bromwich factory for 1,000 Spitfire IIIs, but these were eventually completed as Spitfire Vs and IXs, and a further 120 Spitfire IIIs simultaneously ordered from Supermarine were subsequently cancelled.

Development of the Spitfire IV proceeded in parallel with that of the Mk.III, and this version, intended to be powered by the early single-stage Griffon IIB driving a four-blade airscrew, embodied extensive airframe redesign. At one stage it was proposed to arm the Spitfire IV with six 20-mm. cannon and the prototype (DP845) was actually fitted with a mock-up wing embodying this armament. Before DP845 had flown, however, the Spitfire P.R.IV with the Merlin 45 Series engine had entered production, and the Griffon-engined prototype was redesignated Spitfire XX to avoid confusion.

The specification relates to the Spitfire IA, figures in parentheses referring to the IIA.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,030 (1,175) *h.p. Rolls-Royce Merlin III (XII) twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Eight* 0.303-*in. Browning machine guns with* 300 (350) *r.p.g.* **Performance:** *Maximum speed,* 365 (357) *m.p.h. at* 19,000 (17,000) *ft.; maximum cruising speed,* 315 (310) *m.p.h. at* 20,000 *ft.; economical cruising speed,* 210 (195) *m.p.h.; maximum range (at economical cruising),* 575 (500) *mls.; initial climb rate,* 2,500 *ft./min.; time to* 20,000 *ft.,* 9.4 (7) *min.; service ceiling,* 34,000 (37,200) *ft.* **Weights:** *Empty,* 4,810 (4,900) *lb.; normal loaded,* 5,784 (5,900) *lb.; maximum,* (6,317) *lb.* **Dimensions:** *Span,* 36 *ft.* 10 *in.; length,* 29 *ft.* 11 *in.; height (airscrew vertical),* 11 *ft.* 5 *in.; wing area,* 242 *sq. ft.*

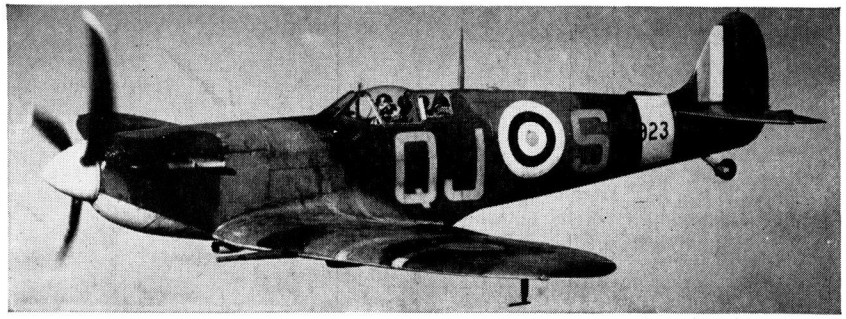
SUPERMARINE SPITFIRE IV, V AND VI — GREAT BRITAIN

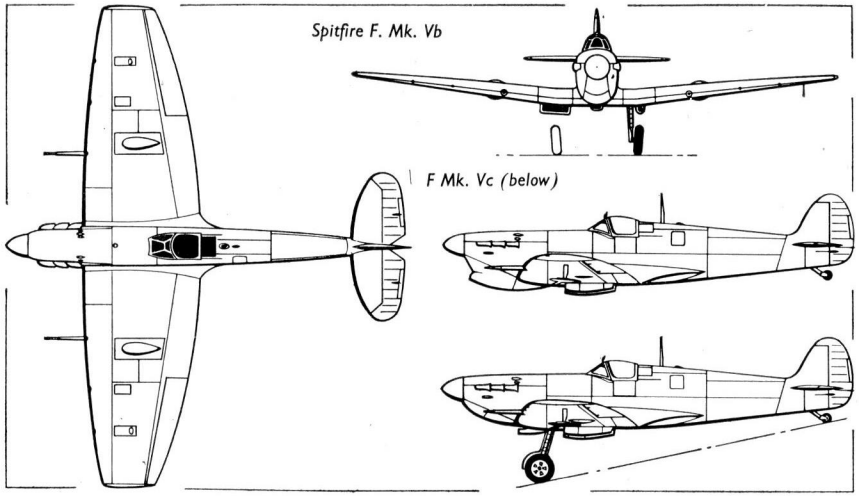
Early variants of the Spitfire were mainly distinguished by engine changes with a progressive increase in power and rated altitude of the Merlin. In 1941 the Merlin 45 Series of two-stage single-speed engines was adopted, and the Spitfire P.R.IV and Spitfire V made their début. Despite its mark number, the Type 349 Spitfire V appeared some considerable time before the Type 353 Spitfire P.R.IV, following the Mk.II into production and reaching the R.A.F. in March 1941, No. 92 Squadron being the first unit to re-equip with this variant. Apart from reinforced longerons, the fuselage of the Spitfire V was similar to that of the Mk.II and, initially, the wing remained unchanged, but weight of armour was increased to 129 lb. on the Spitfire VA and to 152 lb. on the Mk.VB, these having respectively the "A" (eight Browning) and "B" (two Hispano and four Browning) wings. The Spitfire VC introduced the universal or "C" wing first tested on the prototype Spitfire II (N3297), and this variant differed from the Mks.VA and VB also in having a strengthened undercarriage as developed for the Mk.III with the wheels moved two inches forward, and a further increase in armour to 193 lb. Later Spitfire VCs had extended horn balances on the elevators, and still later Mk.VCs had metal-covered ailerons.

The Spitfire Vs were powered by the Merlin 45, 50 or 50A rated at 1,470 h.p. at 9,250 ft., or the Merlin 46 rated at 1,415 h.p. at 14,000 ft. Both Mks.VB and VC could carry a 115 or 175 Imp. gal. drop tank beneath the fuselage, and the Mk.VC could carry either two 250-lb. bombs or one 500-lb. bomb.

In March 1942 fifteen Spitfire VBs were shipped to Malta on H.M.S. *Eagle* to become the first Spitfires to serve outside Europe, and

This Spitfire (R6923) of No. 92 Squadron was built as a Mk.I and converted to Mk.VB standard.





by the following August there were three squadrons of Spitfire Vs in the Western Desert. Early in 1943, fighters of this type flown by No. 54 Squadron were operating in defence of Darwin, Australia, and in October of the same year, three squadrons—Nos. 136, 607, and 615—equipped with Spitfire Vs began operations over Burma. About 300 Spitfire VCs were shipped to Australia in 1943–44. One hundred and forty-three Spitfire VBs (including a number of Mk.II conversions) were shipped to the Soviet Union for Russian use; in 1944 a number of fighters of this type were supplied to the Turkish Air Force; about fifty were supplied to Portugal in 1943, and twelve Spitfire VCs were furnished to the Royal Egyptian Air Force. The U.S.A.A.F.'s 31st and 52nd Fighter Groups were among American units to operate the Spitfire V.

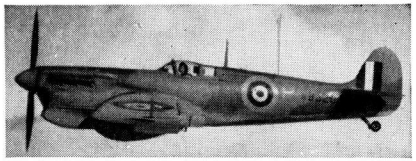
As enemy opposition in the air lessened, the Spitfire was used increasingly for ground strafing, and from 1943 most Spitfire Vs had their wingtips removed and a Merlin 45M, 50M or 55M engine rated at 1,585 h.p. at 2,750 ft., and these aircraft were categorized as low-altitude fighters, this being indicated by the prefix letters "L.F.". A total of 6,479 Spitfire Vs was built; of these, 94 were completed as Mk.VAs, 3,923 as Mk.VBs and 2,447 as Mk. VCs.

Much attention had been given to the use of the Spitfire for photo-reconnaissance from

an early stage in the fighter's development, and early photo-reconnaissance models included a series known as the Spitfire A to G inclusive, these being Spitfire I and II conversions. The Spitfire D denoted a marked step forward in increasing the range of the aircraft. With surprisingly little modification the original wing leading-edge structure was converted into a series of integral fuel tanks with a total capacity of 133 Imp. gal. The result was an unarmed aircraft capable of attaining 372 m.p.h. and possessing a range exceeding 2,000 miles. The Spitfire D was placed in production as the Type 353, and to conform with standard practice was redesignated Spitfire P.R.IV as the fourth P.R. type. A small batch of Spitfire Cs were known as P.R.IIIs in service The Spitfires F and G later became the P.R.VI and VII respectively. Carrying one oblique and two vertical F.24 cameras and powered by the Merlin 45, 46, 50, 55 or 56, the P.R.Mk.IV appeared in September 1941, and 229 were built, serving with Nos. 140, 541, 542, 544, and 681 Squadrons.

The threat of high-altitude bombing from the Luftwaffe in 1941 necessitated investigation of means to increase the altitude performance of the Spitfire. This called for two principal modifications—the introduction of a pressure cabin and the use of an engine suitably rated for higher altitudes. The first version of the Spitfire to be so equipped was the Mk.VI, derived directly from the Mk.VB as a result of work undertaken on pressure cabins by the Royal Aircraft Establishment and Supermarine during 1940–41.

At the R.A.E. one Spitfire (R7120) was fitted with a Merlin 47 offering 1,415 h.p. at 14,000 ft., this being the high-rated version of the Merlin 45, a four-blade Jablo Rotol airscrew and a pressure cabin. This served as the basis for the Type 350 Spitfire VI, one hundred

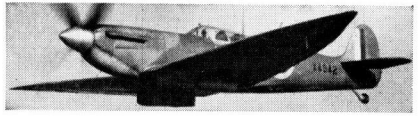


The first tropicalised Spitfire VB (AB320).

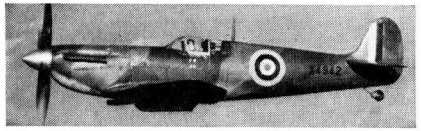
examples of which were built by Supermarine, the first two of these (AB176 and X4942) serving as prototypes. To improve controllability at high altitudes, the production Spitfire VI had an increase in wing area, the wingtips being extended. The pressure cabin was housed between the bulkheads fore and aft of the cockpit, and a special non-sliding canopy was fitted to simplify the sealing problem. In other respects, including armament, the Spitfire VI was similar to the Mk.VB and, an interim type pending production of the Mk. VII, it was restricted to home defence, being flown by five squadrons—Nos. 117, 124, 521, 602 and 616—during 1942–43.

The first of the following specifications relates to the Spitfire VC, figures in parentheses relating to the low-altitude L.F.Mk.VC. The second specification is for the Spitfire VI.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,470 (1,585) *h.p. Rolls-Royce Merlin* 45 (45*M*) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g. or four Hispano cannon with* 120 *r.p.g., plus one* 500-*lb. or two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 374 (357) *m.p.h. at* 13,000 (6,000) *ft.; maximum cruising speed,* 322 (272) *m.p.h. at* 20,000 (5,000) *ft.; economical cruising,* 226 (195) *m.p.h.; time to*



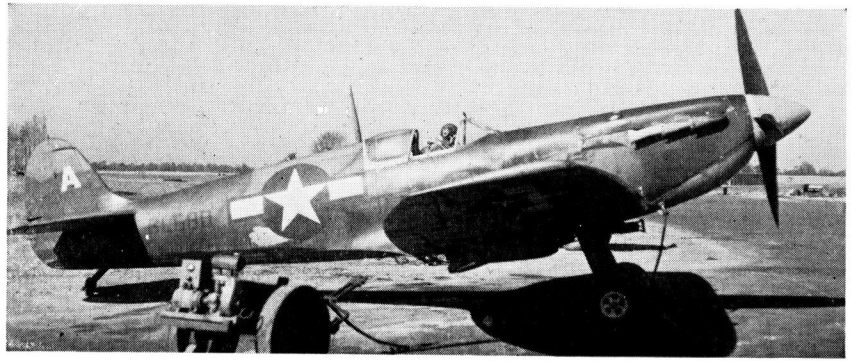
Above and below) The first true prototype of the Spitfire VI (X4942). Originally built as a Mk.I. It was fitted with a pressure cabin, the high-rated Merlin 47 and extended wings.



Many Spitfire VBs were transferred to the 8th A.F., one of these (BL680) with clipped wings being illustrated below.

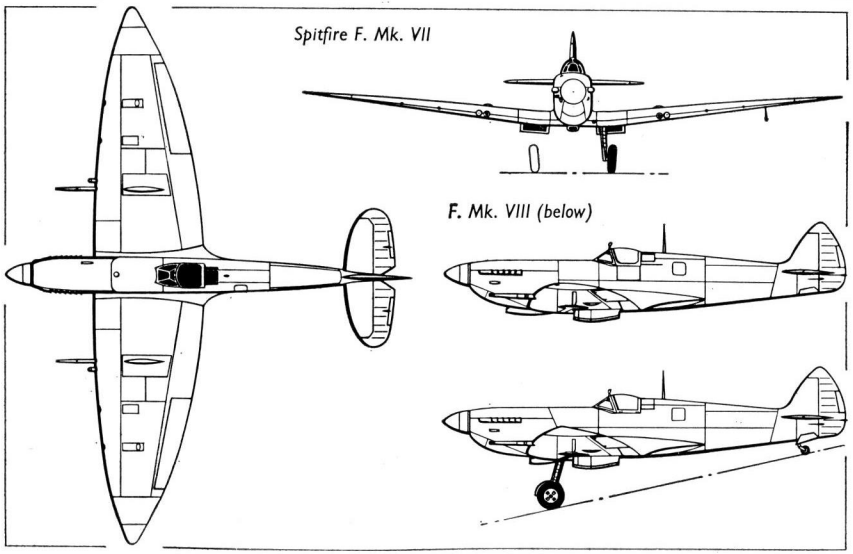
20,000 (5,000) *ft.*, 7.5 (1.6) *min.*; *service ceiling*, 37,000 (36,500) *ft.*; *range* (*internal fuel*), 470 (475) *mls.*, (*max. external fuel*) 1,135 (990) *mls.* **Weights:** *Empty*, 5,100 *lb.*; *loaded*, 6,785 *lb.* **Dimensions:** *Span*, 36 *ft.* 10 *in.* (32 *ft.* 7 *in.*); *length*, 29 *ft.* 11 *in.*; *height* (*airscrew vertical*), 11 *ft.* 4¾ *in.*; *wing area*, 242 (231) *sq. ft.*

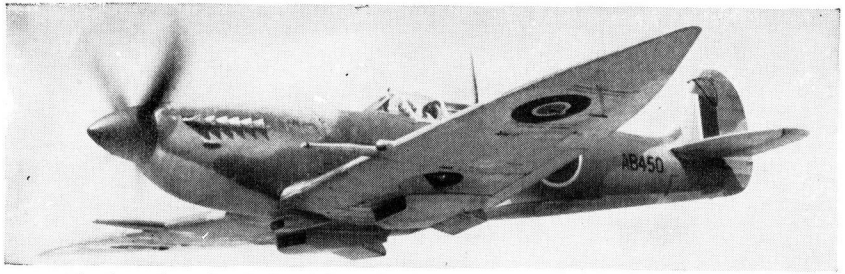
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,415 *h.p. Rolls-Royce Merlin* 47 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 60 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g.* **Performance:** *Maximum speed*, 364 *m.p.h. at* 22,000 *ft.*; *maximum cruising speed*, 325 *m.p.h. at* 20,000 *ft.*; *economical cruising*, 239 *m.p.h.*; *time to* 20,000 *ft.*, 8 *min.*; *service ceiling*, 40,000 *ft.*; *range* (*internal fuel*), 510 *mls.*, (*maximum external fuel*) 1,170 *mls.* **Weights:** *Empty*, 5,300 *lb.*; *maximum loaded*, 7,178 *lb.* **Dimensions:** *Span*, 40 *ft.* 2 *in.*; *length*, 30 *ft.* 2½ *in.*; *height* (*airscrew vertical*), 11 *ft.* 4¾ *in.*; *wing area*, 248.5 *sq.ft.*



SUPERMARINE SPITFIRE VII AND VIII — GREAT BRITAIN

Whereas the Spitfire VI had been, in effect, an emergency high-altitude fighter, the Type 351 Spitfire VII was a more extensive redesign for high-altitude work, and was the first Spitfire variant intended from the outset to make use of the two-speed Merlin 60 series of engines. The two-stage engine was coupled with a redesigned cooling system which showed itself in the enlarged air intake under the port wing which now matched that to starboard. Structural changes were made to the fuselage to take the increased engine loads, and a double-glaze sliding hood was fitted to the cockpit. The wing outline remained similar to that of the Mk.VI, but the ailerons were reduced in span. The larger engine necessitated the lengthening of the nose and the use of an airscrew of higher solidity, and on later production Spitfire VIIs to counteract the destabilizing effect of this additional forward side area substantial increases were made in the chord and area of the vertical tail surfaces. The retractable tailwheel





The first of one hundred and forty Spitfire VIIs (AB450). The symmetrical under-wing radiators are noteworthy.

first developed for the Spitfire III was applied in production for the first time on the Mk.VII, and the universal or "C" wing was employed, with 14 Imp. gal. leading-edge fuel tanks.

One hundred and forty Spitfire VIIs (commencing with AB450 which flew in April 1942) were built, and these equipped nine squadrons —Nos. 32, 41, 92, 124, 133, 417, 485, 602, and 616—at home and in the Middle East. Power was provided by the 1,520 h.p. Merlin 61 or 1,710 h.p. Merlin 64. The Spitfire VII fighter should not be confused with the earlier Spitfire P.R.VII which did not, in fact, bear any direct relationship to the later machine, being the production version of the original Spitfire G. A fighter-reconnaissance aircraft developed in parallel with the P.R.Mk.IV, the P.R.Mk.VII, was powered by the Merlin 45 or 46 and retained the standard "A" wing armament of eight Browning guns. Sixteen machines were later converted to low-level Spitfire P.R.XIIIs by the installation of the low-rated Merlin 32 of 1,645 h.p.

Apart from the pressure cabin, most of the modifications introduced on the Mk.VII fighter were applicable to the standard range of Spitfires, and these were embodied by the Type 359 Spitfire VIII which was, in essence, the complement of the Mk.VII for operation at lower altitudes. Lacking the Mk.VII's pressure cabin, all production Spitfire VIIIs had a Vokes Aero Vee tropical filter fitted on the air intake as standard, and a total of 1,658 Spitfires of this type were built in three main versions: the F.VIII with a Merlin 61 or 63 engine (267 built), the H.F.VIII with a Merlin 70 (160 built), and the L.F.VIII (1,225 built) with the lower altitude-rated Merlin 66. The three versions were respectively fitted with standard, extended and clipped wings, the extended wings being similar to those of the Spitfire VII. Six Mk.VIIIs were completed as prototypes for the Mk.XIV.

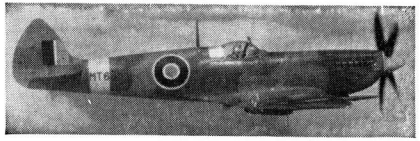
The Spitfire F.VIII entered service in the Mediterranean theatre in August 1943, the first unit to receive this type being No. 145 Squadron in Italy. No. 155 Squadron. which operated over the Soviet Union for a short time with F.Mk.VIII fighters, began operations over Burma in December 1943. A further

fifteen squadrons, including several of the R.A.A.F., operated Spitfire VIIIs in the Far East, and No. 253 Squadron operated fighters of this type with the Balkan Air Force. Several experimental versions of the Spitfire VIII were flown, including JF299 with the first all-round-vision cockpit canopy and cut-down rear fuselage, and JK535 with an experimental contra-prop installation.

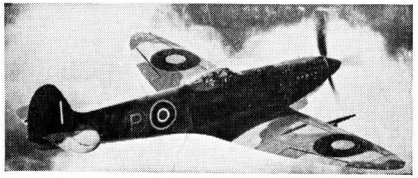
The first of the following specifications relates to the Spitfire VII, and the second specification covers the Spitfire F.VIII, figures in parentheses relating to the L.F.VIII.

Type: *Single-seat High-altitude Interceptor Fighter.* **Power Plant:** *One* 1,710 *h.p. Rolls-Royce Merlin* 64 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g.* **Performance:** *Maximum speed,* 408 *m.p.h. at* 25,000 *ft.,* 382 *m.p.h. at* 12,500 *ft.; maximum cruising speed,* 324 *m.p.h. at* 20,000 *ft.; economical cruising,* 220 *m.p.h.; range (internal fuel),* 660 *mls., (maximum externa fuel)* 1,180 *mls.; time to* 20,000 *ft.,* 7.1 *min.; service ceiling,* 43,000 *ft.* **Weights:** *Empty,* 6,000 *lb.; maximum loaded,* 7,875 *lb.* **Dimensions:** *Span,* 40 *ft.* 2 *in.; length,* 31 *ft.* 3½ *in.; height (airscrew vertical),* 12 *ft.* 7¼ *in.; wing area,* 248.5 *sq. ft.*

Type: *Single-seat Interceptor and Fighter-bomber.* **Power Plant:** *One* 1,710 (1,720) *h.p. Rolls-Royce Merlin* 63 (66) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g., or four* 20-*mm. Hispano cannon with* 120 *r.p.g., plus one* 500-*lb. and two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 408 (404) *m.p.h. at* 25,000 (21,000) *ft.,* 382 (384) *m.p.h. at* 12,500 (10,500) *ft.; maximum cruising speed,* 324 (328) *m.p.h. at* 20,000 *ft.; range (internal fuel),* 660 *mls., (max. external fuel)* 1,180 *mls.; time to* 20,000 *ft.,* 7 (6.7) *min.; service ceiling,* 43,000 (41,500) *ft.* **Weights:** *Empty,* 5,800 *lb.; maximum loaded,* 7,767 *lb.* **Dimensions:** *Span,* 36 *ft.* 10 *in.* (32 *ft.* 7 *in.*); *length,* 31 *ft.* 3½ *in.; height (airscrew vertical),* 12 *ft.* 7¼ *in.; wing area,* 242 (231) *sq. ft.*



(Above) Early production Spitfire VIII (MT655)

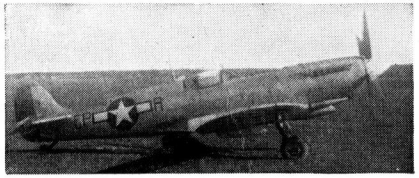


(Above) Spitfire VIII (JF299) with bubble canopy.

(Above) Spitfire VIII (JF321) with two-stage Griffon and contra-prop.

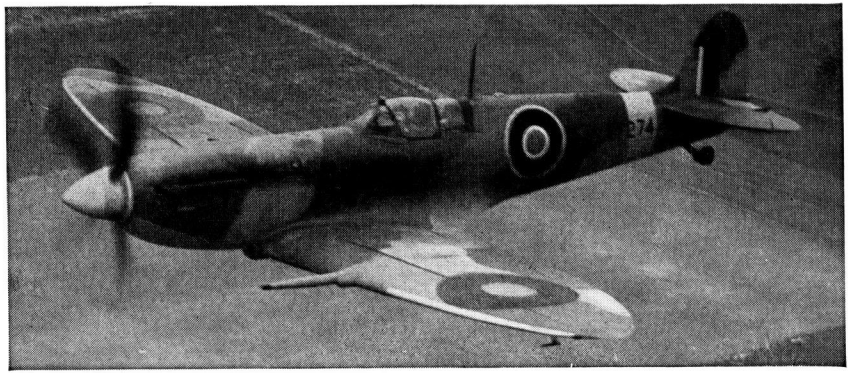
SUPERMARINE SPITFIRE IX, X, XI, AND XVI GREAT BRITAIN

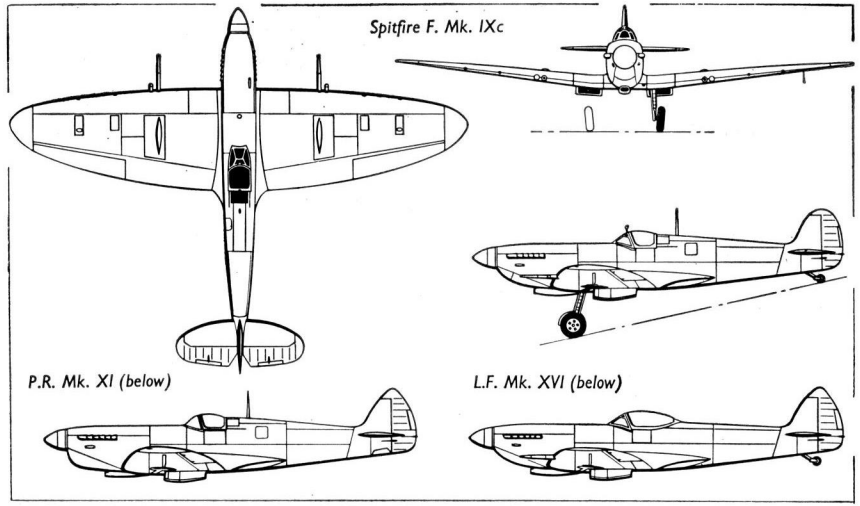
By the end of 1941, the Spitfire V was experiencing increasing difficulty in combating the newer versions of the Messerschmitt Bf 109 and found itself completely outclassed by the Fw 190A. The Spitfires VII and VIII were under development, but the need for a higher performance than that offered by the Mk.V was a matter of the most vital urgency. In order to achieve the desired performance improvement with the least possible delay, it was decided to install the Merlin 60 Series engine in the basic Spitfire VC airframe, this marriage of convenience being designated Type 361 Spitfire IX. Despite the fact that the Spitfire IX was considered solely as an interim type, it was to be produced in larger quantities than any other Spitfire variant, and of the 5,665 aircraft of this type manufactured (4,010 L.F.IXs, 1,255 F.IXs and 400 H.F.IXs), no less than 1,188 were shipped to the Soviet Union, all but two of these being L.F.IXs.



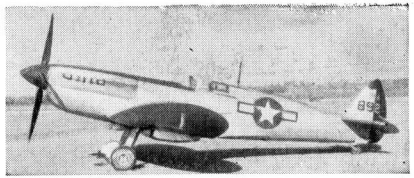
Apart from the changes necessitated by the installation of the two-speed two-stage Merlin with its four-blade Rotol airscrew, no modifications were made to the basic Mk.VC airframe. Depending on the particular version of the Merlin fitted, the Spitfire IXs were categorised as L.F., F., or H.F. (low-, medium-, or high-altitude), but no external changes distinguished these variants. The first Spitfire IXs reached No. 64 Squadron in July 1942, and this version substantially reduced—although failed to eliminate—the margin of ascendancy possessed by the Fw 190A. The difficulty experienced by Luftwaffe pilots in distinguishing between the Spitfire IX and the inferior Mk.V at combat range endowed R.A.F. pilots with some tactical advantage at first.

(Above, left) One of sixteen Mk.IXs transferred to the U.S.A.A.F and (below) a standard Mk.IX (BF274).





Early production Spitfire IXs had the universal or "C" wing, but by 1944 the firepower had been boosted by the introduction of the so-called "E" wing. The two 0.303-in. guns were replaced by a single 0.5-in. gun which was mounted in what had been the inner cannon bay of the "C" wing, the 20-mm. gun being moved to the outboard position. Later in its service life the Spitfire IX was adapted for use principally in the ground-attack role, having been replaced as an interceptor by Griffon-engined models. Since these operations were invariably conducted at low altitudes, the wings were frequently clipped to the 32 ft. 7 in. span. Another later modification



One of eight U.S.A.A.F. Spitfire P.R.XIs.

was the introduction of a rear fuselage fuel tank of 72 Imp. gal. capacity, and the enlarged vertical tail surfaces also became standard, together with metal-covered elevators.

One Spitfire IX (MJ892) was fitted with twin floats, but this, together with the three Spitfire Vs similarly equipped, is described in one of the companion volumes entitled *Flying Boats and Floatplanes.*

Logical evolutions of the Spitfire IX were the photo-reconnaissance P.R.Mks.X and XI. The P.R.Mk.X was developed in parallel with the Mk.IX but was not produced until 1944. The Spitfire P.R.X featured a pressure cabin, and the sixteen examples built were initially powered by the Merlin 64, but this was later supplanted by the Merlin 77. Cabin pressurization was generally considered to be an unnecessary luxury for photographic reconnaissance duties, however, and the Spitfire P.R.XI did not possess this feature. This variant, which entered production in 1942, was powered by the Merlin 61, 63 or 63A, and, in the final production batches, the Merlin 70. A universal camera installation provided accommodation for two F.8 or two F.52 vertical cameras, or two F.24 vertical and one F.24 oblique camera. A number of Spitfire IXs were converted for photo-reconnaissance by the R.A.F.'s P.R. Unit at Benson, but these conversions were not up to true P.R.Mk.XI standards. Four hundred and seventy-one Spitfire P.R.XIs were manufactured.

A close relative to the Spitfire IX was the Type 361 Spitfire L.F.XVI which differed in having a low-rated Packard-built Merlin 266. Like the Mk.IXs, the Mk.XVI was initially produced with the "C" wing which was usually clipped, but later the "E" wing was introduced, together with the enlarged vertical tail, while at about the same time the rear-view hood was adopted as standard for this variant. From 1944 onwards, 1,054 Spitfire XVIs were delivered, this being the last major production model of the Merlin-engined Spitfire, and the type entered service with the 2nd T.A.F. as a ground-attack fighter. By May 1945, Spitfire XVIs were still serving with eleven 2nd T.A.F. squadrons and four squadrons of R.A.F. Fighter Command.

The following specification relates to the Spitfire L.F.IXE and is also applicable to the L.F.XVIE, figures quoted in parentheses relating to the H.F.IXE.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,720 (1,710) *h.p. Rolls-Royce Merlin* 66 (70) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and two* 0.5-*in. Browning machine guns with* 250 *r.p.g., plus one* 500-*lb. and two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 404 (416) *m.p.h. at* 21,000 (27,500) *ft.,* 384 (396) *m.p.h. at* 10,500 (15,000) *ft.; maximum cruising speed,* 328 (322) *m.p.h. at* 20,000 *ft.; range* (*on internal fuel at* 220 *m.p.h.*), 434 *mls.,* (*with maximum external fuel*) 980 *mls.; time to* 20,000 *ft.,* 6.4 *min.; service ceiling,* 42,500 (45,000) *ft.* **Weights:** *Empty,* 5,800 *lb.; maximum loaded,* 7,500 *lb.* **Dimensions:** *Span,* 32 *ft.* 7 *in.* (36 *ft.* 10 *in.*); *length,* 31 *ft.* 4 *in.; height* (*airscrew vertical*), 12 *ft.* 7¼ *in.; wing area,* 231 (242) *sq. ft.*

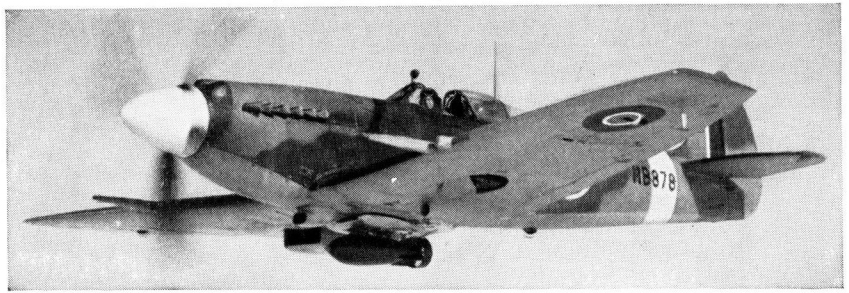
SUPERMARINE SPITFIRE XII, XIV, XVIII AND XIX G.B.

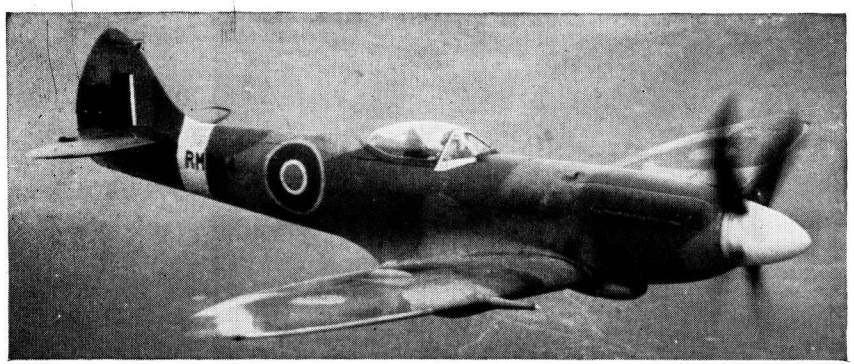
Reference has already been made (page 96) to the Spitfire IV powered by the Griffon engine and redesignated Mk.XX prior to flight testing to avoid confusion with the P.R.Mk.IV. The original intention was that all Griffon-powered Spitfires would be designated in the XX Series, but this plan was not adhered to when the interim Griffon-powered Marks XII, XIV, XVIII and XIX were produced. The Spitfire IV alias XX (DP845) was made the subject of production contracts during the period that the prototype was under development, and 750 were ordered from the Castle Bromwich factory on August 23, 1941, but, in fact, none was produced in this form. However, when in 1942 the need arose suddenly for a high-performance low-altitude fighter to combat the low-flying Fw 190A sneak raiders whose depredations were becoming an increasing nuisance, experience with DP845 was employed to produce the interim Type 366 Spitfire XII.

The Spitfire XII was essentially a strengthened Mk.VC airframe with special attachments at frame 5 for the semi-cantilever beam-type mounting of the Griffon III or IV engine which drove a four-blade Rotol Jablo airscrew. A broad chord fin-and-rudder assembly was necessitated by the lengthened forward fuselage, the wings were clipped, and, later, a retractable tailwheel was applied. One hundred Spitfire XIIs were built (fifty based on Mk.V airframes and fifty on Mk.VIII airframes), and these were used with effect by Nos. 41 and 91 Squadrons from Hawkinge on home-defence duties from the spring of 1943.

In order to gain experience with the two-stage Griffon engine for the Type 356 Spitfire 21 which was then considered to be the definitive Griffon-powered machine, six Spitfire VIII airframes (JF316 to 321 inclusive) were allocated for flight development (JF321 with a contraprop). Trials with these experimental

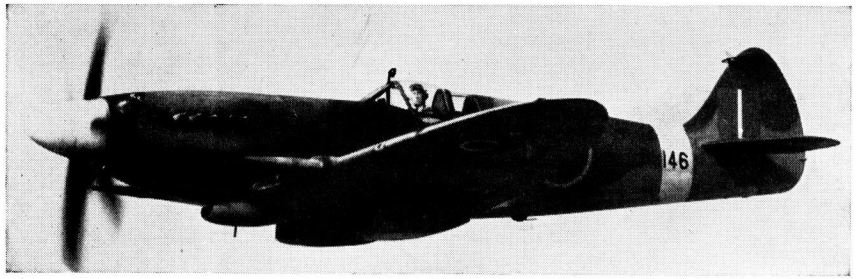
This Spitfire XII (MB878) employed a Mk.VIII airframe, but Mk.XIIs employing Mk.V airframes featured a fixed tailwheel.

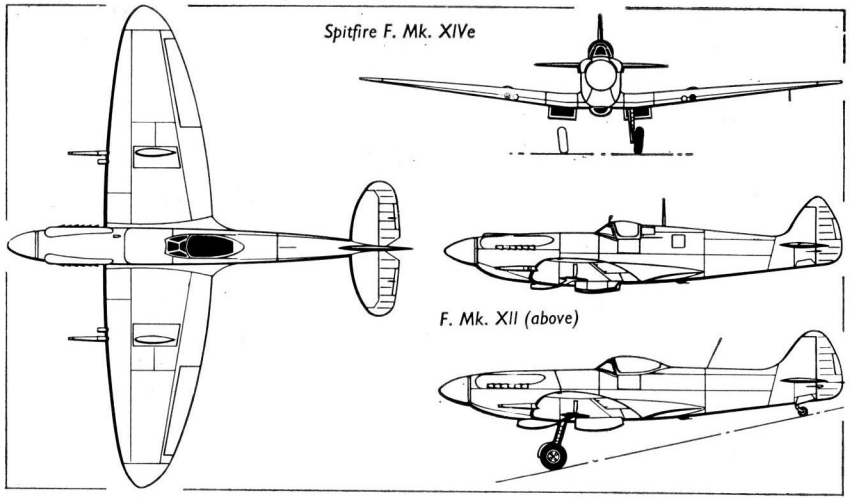




machines proved so satisfactory that it was decided to produce another interim Griffon-powered variant, the Type 372 Spitfire XIV. As initially produced, the Spitfire XIV had what was, apart from some strengthening of the fuselage, a standard Mk. VIII airframe married to a Griffon 65 engine which drove a five-blade Rotol airscrew. The vertical surfaces were enlarged in a similar fashion to those of the Mk.XII except that the chord of

(Above) A Spitfire Mk.XIVE with all-round vision canopy and (below) the seventh Spitfire (RB146) built to full Mk.XIV standard with enlarged tail.

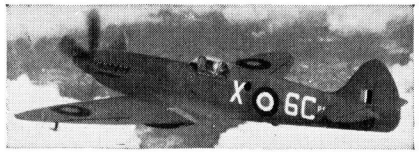




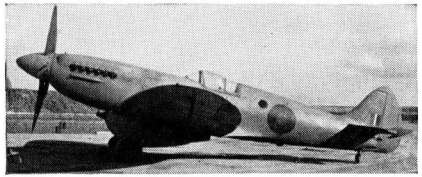
the fin was still further increased, and the "C" wing was used. This was eventually supplanted by the "E" wing, and the last few Mk.XIVs built had the all-round-vision cockpit canopy and cut-down rear fuselage.

A separate production batch, designated F.R.XIVE, featured an oblique F.24 camera in the rear fuselage and clipped wings. This served as a low-level tactical reconnaissance fighter in Europe, and combined production of Spitfire XIVs totalled 957 (527 fighter and 430 fighter-reconnaissance) aircraft. The Spitfire XIV gained the distinction of destroying the first Me 262 in fighter-versus-fighter combat, this event taking place on October 5, 1944, the Spitfire belonging to No. 401 Squadron. Spitfire XIVs had first entered service on January 1 1944, with No. 610 Squadron, and aircraft of this type went to twenty 2nd T.A.F. squadrons. The type was in process of entering service with squadrons in the Far East as the war ended.

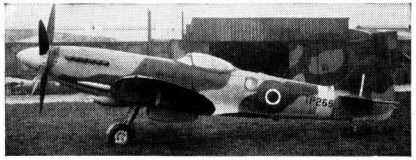
To consolidate the Mk.XIV type, Supermarine developed a further version, the Type 394 Spitfire XVIII in which the fuselage and undercarriage were again strengthened to permit an increase in all-up weight consequent upon the introduction of additional fuel tanks in the wings (26.5 Imp. gal.) and rear fuselage (66 Imp. gal.). Among the most radical changes



(Above) Spitfire XIX (PM655) and (below) Mk. XIX (PS858) with long-range fuel tank.



(Below) Spitfire F.R.XVIII (TP265).



in this variant were the modifications made to the wing, which was substantially strengthened by the use of an extruded section main spar in place of the telescopic duralumin tubing previously employed. The extruded section presented some production problems, in the event, and was not used by the definitive Spitfire 21. Versions both with and without an oblique camera in the rear fuselage, designated F.R. and F.XVIII respectively, were produced, but contracts were cut at the end of the war and actual production totalled only three hundred (100 F.XVIIIs and 200 F.R. XVIIIs), the type never becoming operational since it was delivered to the squadrons only shortly before hostilities terminated.

The only Griffon-powered unarmed photo-reconnaissance model of the Spitfire was the P.R.Mk.XIX which was basically a Mk.XIV airframe with a modified Mk.VC wing similar to that employed by the P.R.Mks.X and XI. Twenty unpressurized pre-production Spitfire P.R.XIXs were manufactured, these being powered by the Griffon 65, but subsequent machines were fully pressurized and powered by the Griffon 66, 225 being built (including the pre-production aircraft). After operating over Europe during the closing stages of hostilities, the P.R.XIX appeared in the Far East.

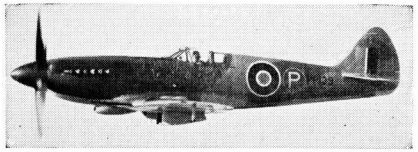
The specification relates to the Spitfire XII, figures in parentheses relating to the XIVE.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,735 (2,050) *h.p. Rolls-Royce Griffon III or IV* (65) *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g.* (*two* 0.5-*in. Browning guns with* 250 *r.p.g.*) *plus one* 500-*lb.* (*and two* 250-*lb*) *bomb*(*s*). **Performance:** *Maximum speed,* 393 (448) *m.p.h. at* 18,000 (26,000) *ft.,* 372 (417) *m.p.h. at* 5,500 (12,000) ft.; *maximum cruising speed,* 364 (362) *m.p.h. at* 20,000 *ft.; range* (*internal fuel*), 329 (460) *mls. at* 263 (245) *m.p.h.,* (*max. auxiliary fuel*) 493 (850) *mls.; time to* 20,000 *ft.,* 6.7 (7) *min.; service ceiling,* 40,000 (44,500) *ft.* **Weights:** *Empty,* 5,600 (6,600) *lb.; maximum loaded,* 7,400 (8,500) *lb.* **Dimensions:** *Span,* 32 *ft.* 7 *in.* (36 *ft.* 10 *in.*); *length,* 31 *ft.* 10 *in.* (32 *ft.* 8 *in.*); *height* (*airscrew vertical*), 11 *ft.* 0 *in.* (12 *ft.* 8½*in.*); *wing-area,* 231 (242) *sq. ft.*

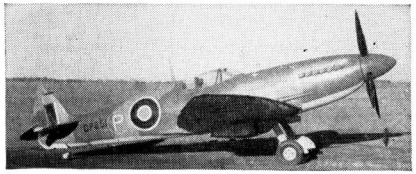
SUPERMARINE SPITFIRE 21 AND 22

One of the many distinctions gained by the Spitfire was that of being the only Allied fighter in production at the beginning of the Second World War to remain in continuous production until the termination of the conflict. Although very few details remained unaltered during the Spitfire's production life, the design principles and layout on which the fighter was originally based persisted throughout. Fundamental changes were proposed from time to time, but the advantages offered by these changes were too nebulous to make worthwhile any radical departure from the tried and proven. The Spitfire did undergo two major redesigns during its career, however, these producing the Marks VIII and 21, and with the appearance of the latter, the Spitfire lost the classic elliptical wing planform which, until that time, had been considered as synonymous with this remarkable fighter.

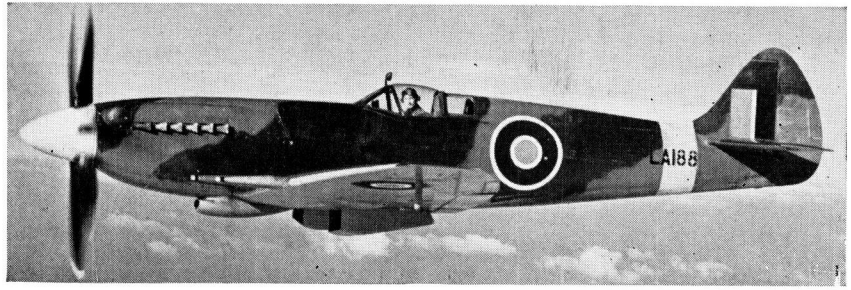
With the constant increase in operational speeds the effect of torsional stiffness of the



(Above) Second prototype Spitfire 21 (*PP*139), *and (below) first prototype Mk.*21 (*DP*851), *the second Griffon-powered Spitfire.*

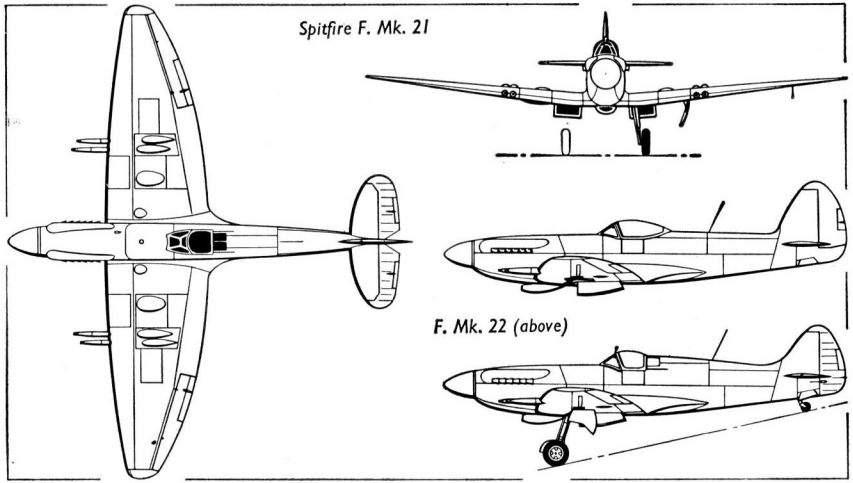


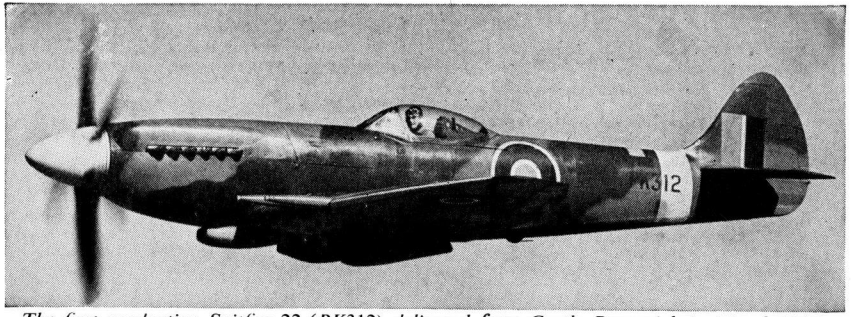
Second production Spitfire 21 (*LA*188). *This variant was delivered to No.* 91 *Squadron shortly before end of W.W.II.*



wings on aileron effectiveness assumed major importance, and whereas a theoretical reversal speed of 580 m.p.h. had been catered for by the wings of earlier Spitfires, that of the Mark 21 featured a forty-seven per cent increase in stiffness which catered for a theoretical reversal speed of no less than 825 m.p.h. This increase in stiffness was obtained by major structural alterations, including higher tensile spar booms and heavier gauge wing plating. Plain ailerons with balance tabs supplanted the metal-covered Frise-type ailerons, the fuselage was strengthened for increased loads as was also the undercarriage, which featured outer wheel flaps, and the tail surfaces were re-designed and enlarged.

The Spitfire 21 stemmed from a second Griffon-engined prototype (DP851), which was ordered at the same time as the original Griffon-powered Mk.IV/XX prototype (DP 845), and was developed to take the two-stage Griffon 61 Series engine. It featured several other important changes, principally concerning the wing, and a later prototype (PP139) was also used to develop these modifications. The extended-span wing of the Spitfires VI and VII was further modified in form for these aircraft, and these served as prototypes of the definitive Spitfire 21, 1,500 of which were laid down at Castle Bromwich on July 17, 1943. The first production Spitfire 21 (LA187) appeared in February 1944, and was the first





The first production Spitfire 22 (PK312) delivered from Castle Bromwich in March 1945.

machine to embody the redesigned wing. Deliveries of the Spitfire 21 to the R.A.F. commenced shortly before the end of the war. No. 91 Squadron at West Malling being the first unit to re-equip, but the type was too late to see war service and, in August 1945, the original order was largely cancelled, only 122 Spitfire 21s being completed.

In March 1945 a further variant appeared, the Spitfire 22, the first production aircraft being PK312. This differed from the Mk.21 principally in having an all-round-vision canopy and cut-down rear fuselage, and some machines had a Griffon 85 in place of the Griffon 61 or 64 driving contraprops. Deliveries of the Spitfire 22 to the R.A.F. did not commence until after the end of the war, when 278 fighters of this type were completed, and the final production variant, the Mk.24, was an exclusively post-war version, of which fifty-four were built.

The Marks 21 and 22 undoubtedly brought the Spitfire to the peak of perfection, and when the last production machine was delivered in October 1947, the total number of Spitfires of all types built for the R.A.F. had reached 20,334 machines, and of these 2,053 were powered by the Griffon engine.

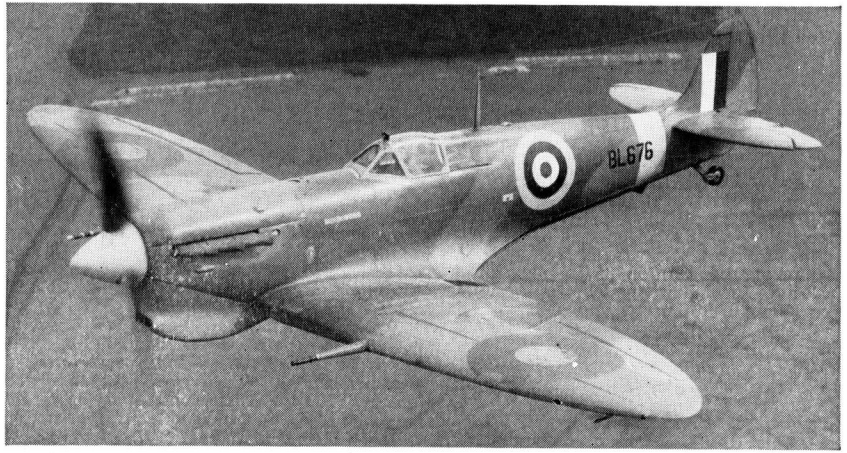
The specification relates to the Mk. 21.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 2,050 *h.p. Rolls-Royce Griffon* 61 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano Mk.II cannon with* 150 *r.p.g. outboard and* 175 *r.p.g. inboard, plus one* 500-*lb. and two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 420 *m.p.h. at* 12,000 *ft.,* 454 *m.p.h. at* 26,000 *ft.; maximum cruising speed,* 385 *m.p.h. at* 20,000 *ft.; range (internal fuel),* 490 *mls. at* 284 *m.p.h., (maximum auxiliary fuel)* 880 *mls.; time to* 20,000 *ft.,* 8 *min.; service ceiling,* 43,500 *ft.* **Weights:** *Empty,* 6,900 *lb.; maximum loaded,* 9,200 *lb.* **Dimensions:** *Span,* 36 *ft.* 11 *in.; length,* 32 *ft.* 8 *in.; height (airscrew vertical),* 13 *ft.* 6 *in.; wing area,* 244 *sq. ft.*

In view of the successful adaptation of the Hawker Hurricane for shipboard use, it was to be expected that an attempt would be made to "navalise" the Spitfire, for the Fleet Air Arm still lacked a shipboard fighter with a performance comparable with contemporary land-based machines. Thus, in 1941, when the war at sea had reached a highly critical phase, a production Spitfire VB was fitted with an A-frame arrester hook and, late that year, completed a series of deck-landing trials aboard H.M.S. *Illustrious*. Anticipated difficulties resulting from the Spitfire's landing speed—which, at 85 m.p.h., was then appreciably higher than that considered to be normally acceptable for deck requirements—did not arise, and Air Service Training at Hamble were immediately instructed to convert forty-eight and then a further one hundred and eighteen Mk.VBs to "hooked" Spitfires which were then dubbed Type 340 Seafire IB.

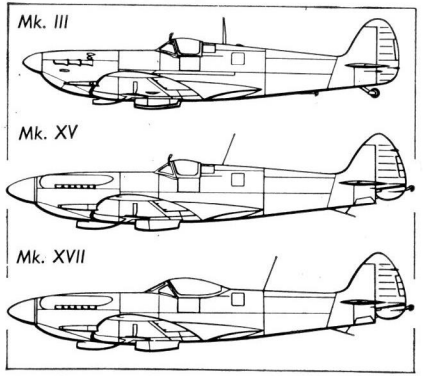
Apart from the arrester hook and slinging points, the Seafire IB was almost identical to its land-based counterpart, and the 166 conversions were powered by the Merlin 45, 46, 50, 50A, 55 or 56 according to the Spitfire converted. The Seafire IB was fitted with the standard "B" wing with the standard armament (one 20-mm. Hispano and two 0.303-in. Brownings in each wing), and the first F.A.A. unit to operate this type, No. 807 Squadron, received its aircraft in June 1942 and, together with No. 801 Squadron which had been similarly equipped in September, joined H.M.S. *Furious* in time to participate in the Allied invasion of North Africa in November 1942.

This Seafire IB (BL676) was the first of the initial batch of Spitfire VBs to be navalised.

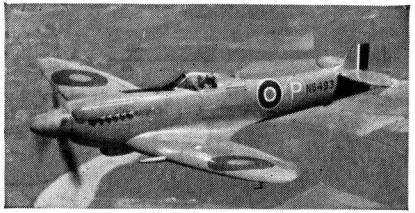


Whereas all Seafire IBs were conversions, the Type 351 Seafire IIC was based on the Spitfire VC with the universal or "C" wing, and was built from the outset for shipboard operations. This variant featured reinforced longerons to permit the attachment of catapult spools, and the undercarriage was strengthened. Two versions were produced; the Supermarine-built Seafire F.IIC and the Westland-built Type 375 Seafire L.F.IIC. The latter was fitted with a low-rated Merlin 32 of 1,645 h.p. driving a four-bladed airscrew, and 262 F.Mk.IICs and 110 L.F.Mk.IICs were built. A few of these were fitted with mountings for one oblique and one vertical camera as P.R.Mk.IICs. Seafire IICs embarked on H.M.S. *Formidable*, joining Force H in the Ionian Sea to participate in the invasion of Sicily.

The comprehensive operational deployment of the Seafire presented major problems owing to the lack of wing folding which complicated deck handling and prevented the fighter utilising hangar lifts. The question of providing the Seafire with a folding wing had been considered as early as 1941, but the folding of such a thin wing appeared to present insoluble problems if loss of stiffness and excessive weight were to be avoided. After considerable experimentation it was found possible to introduce two straight fore and aft folds. The folding wing was hinged and arranged to lift vertically from a point relatively near the root, and a second fold at the wingtip joint turned downwards. The wing folding increased the total weight by only 125 lb., and the decrease in torsional rigidity was ten per cent.



After prototypes converted from Spitfire VCs had been tested with the manually-folding wing, this development was applied to a new production model, the Type 358 Seafire III. Quantity production of the Seafire III was undertaken by both Westland Aircraft and Cunliffe-Owen Aircraft, a total of 1,220 machines being built, 350 of these by Cunliffe-Owen, the first twenty of which had three-blade airscrews in place of the standard four-blade. One hundred and twenty-nine Cunliffe-Owen-built aircraft were equipped with a pair of F.24 cameras and designated F.R.Mk.III, and the Seafire L.F.Mk.III was the low-altitude variant. Variants of the Merlin engine installed included the 45, 46, 50, 50A, 55, and 56; all Seafire IIIs could be fitted with rocket-assisted take-off equipment and could carry two 250-lb. or one 500-lb. bomb, and they were flown with both clipped and full-span wings.



The prototype Seafire XVII (NS493).

The Seafire is undoubtedly best-remembered for its part in the Allied landing at Salerno, on September 9, 1943, when it provided close support for the invading troops virtually unaided for the first four critical days of the battle. Seafire squadrons operated with the Desert Air Force and, on D-Day, June 6, 1944, Seafires were in the forefront of the battle, target-finding for the Navy's heavy guns. Towards the end of 1944, Seafire IIIs made their appearance in the Far East where they commenced operations on January 24, 1945, participating in a full-scale attack against oil targets in Sumatra. At the time of VJ-Day, Seafire IIIs equipped eight F.A.A. first-line squadrons, four further squadrons equipped with the Griffon-powered Seafire XV being in process of working up in the United Kingdom.

Paralleling Spitfire development, the Griffon-engined Type 377 Seafire XV superseded the Merlin-powered Seafire III in production in 1944. This had the naval features of the Seafire III combined with a 1,850 h.p. Griffon VI driving a four-blade airscrew, and some features of the Spitfire XII such as the large chord rudder. Evolved to specification N.4/43, the six prototypes of the Seafire XV were flown in 1944, and both Westland Aircraft and Cunliffe-Owen Aircraft began production. Whereas the first fifty aircraft retained the old A-frame arrester hook, the fifty-first Seafire XV and subsequent machines were fitted with a sting-type hook. Four squadrons—Nos. 802, 803, 805 and 806—were working up with the Seafire XV when the war terminated, and Westland Aircraft and Cunliffe-Owen Aircraft went on to build 256 and 134 aircraft respectively. A variant differing solely in having an all-round-vision canopy and a cut-down rear fuselage was the Seafire XVII, and the prototype (NS493) which began trials in 1945 was actually the third prototype Seafire XV. Naval equivalents of the Spitfire 21 and 22, designated Seafires 45, 46 and 47, were entirely post-war developments.

The following specification relates to the Seafire F.Mk.III, figures in parentheses referring to the Seafire XV.

Type: *Single-seat Shipboard Fighter-bomber.* **Power Plant:** *One* 1,470 (1,850) *h.p. Rolls-Royce Merlin* 55 *(Griffon VI) twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. Hispano cannon with* 120 *r.p.g. and four* 0.303-*in. Browning machine guns with* 350 *r.p.g. plus one* 500-*lb. or two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 352 (383) *m.p.h. at* 12,250 (13,500) *ft.; maximum cruising speed,* 310 (334) *m.p.h. at* 20,000 *ft.; range (internal fuel),* 465 (430) *mls. at* 218 (255) *m.p.h. at* 20,000 *ft., maximum,* 725 (640) *mls.; time to* 20,000 *ft.,* 8.1 (7) *min.; service ceiling,* 33,800 (35,500) *ft.* **Weights:** *Empty,* 5,400 (6,200) *lb.; loaded,* 7,100 (8,000) *lb.* **Dimensions:** *Span,* 36 *ft.* 10 *in.; length,* 30 *ft.* 2½ *in.* (32 *ft.* 3 *in.*); *height,* 11 *ft.* 2 *in.* (10 *ft.* 8 *in.*); *wing area,* 242 *sq. ft.*

SUPERMARINE SPITEFUL

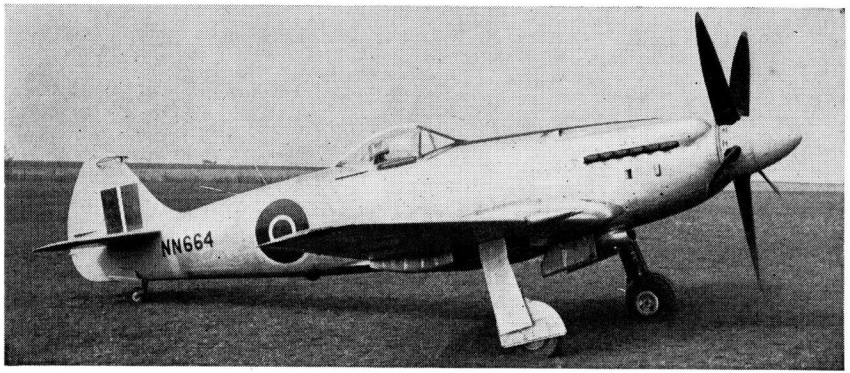
GREAT BRITAIN

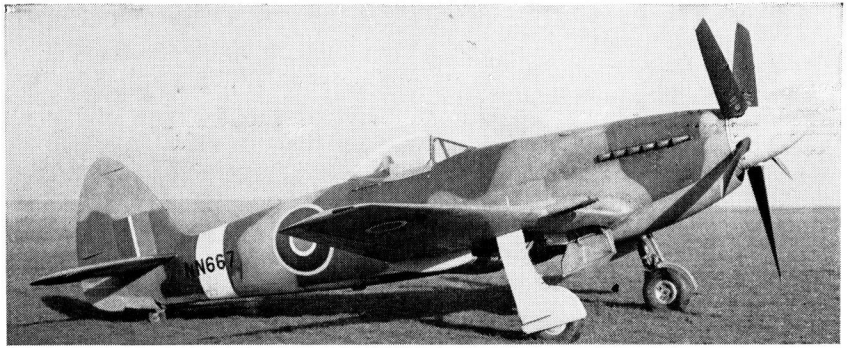
A direct development of the Spitfire, the Spiteful was a handsome fighter which, while retaining some of its predecessor's characteristics, was in fact an entirely new design. In production when the war terminated, the Spiteful was never issued to a squadron, but in its definitive form it gained the distinction of being the fastest piston-engined aircraft ever produced in the United Kingdom.

In 1941, at the behest of the Air Ministry, the Supermarine design team led by Joseph Smith began investigating the possibilities of laminar flow wings (specially shaped aerofoils designed to delay the onset of turbulence in the boundary layer and thus reduce drag), and proposals were made for the use of such wings by a development of the Griffon-engined Spitfire. Early in 1943, specification F.1/43 was prepared to cover the proposed development and, on October 30, 1943, an order for 373 Spitfire 21s that had been placed with Supermarine on September 1, 1943, was changed to what was then referred to as the "Spitfire F.21 (Laminar Wing)".

The new wing employed Supermarine high-speed section 371, possessing a thickness/chord ratio of thirteen per cent at the root decreasing to eight per cent at the tip, and having maximum thickness at forty per cent chord at the root increasing to forty-two per cent at the tip. It was of single-spar stressed-skin construction with an auxiliary spar, and was married to a Spitfire VIII fuselage and tail surfaces and a Rolls-Royce Griffon 61 two-stage engine with a maximum rating of 2,035 h.p. at 7,000 ft. This combination (NN660) flew for the

The second prototype Spiteful (NN664) which was completed late in 1944.



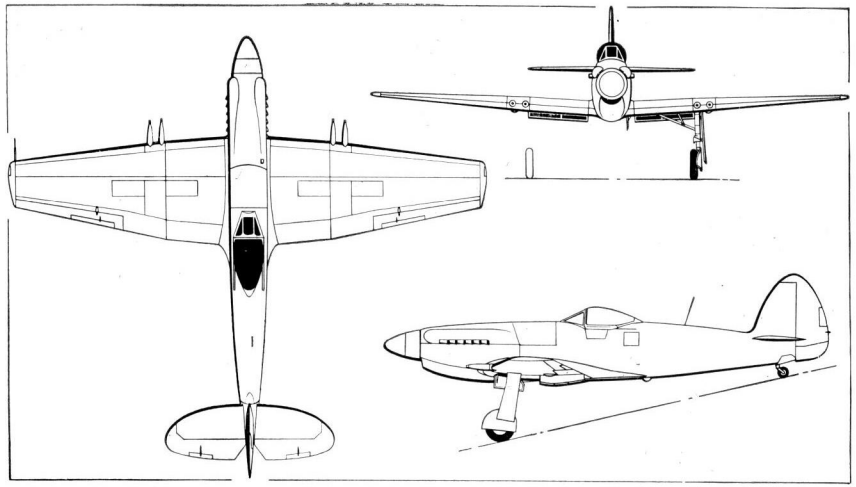


The third prototype Spiteful (NN667) with an extended air intake and redesigned tail surfaces.

first time on June 30, 1944 as the first prototype of the Spiteful.

In the meantime, an entirely new fuselage was being designed for the fighter. This was deeper than that of the Spitfire, conferring improved pilot vision, and lacking, the straight top line of the earlier fighter's fuselage, lost some of the Spitfire's daintiness. The new fuselage was employed by the second Spiteful prototype (NN664) completed late in 1944, by which time the first prototype had been lost in an accident. Other changes introduced by the second prototype included the replacement of the original plain ailerons by slotted ailerons, and the third prototype (NN667) which joined the test programme shortly afterwards had the air intake moved forward to a position immediately aft of the airscrew spinner, and redesigned and enlarged tail surfaces necessitated by the installation of a large-capacity fuel tank immediately aft of the pilot with a consequent change in the position of the c.g.

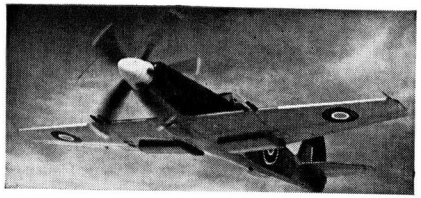
When built by hand, as for the Spiteful prototypes, the laminar flow wings gave excellent results, but from the production viewpoint such wings were not a practical engineering proposition, and it is questionable if the performance increment gained by the use of these wings justified the production problems involved. Nevertheless, by the time the second and third prototypes began flight trials, work on the pre-production model of the fighter, the Type 371 Spiteful XIV, powered by the Griffon 65 rated at 2,050 h.p. at 8,000 ft., had reached an advanced stage, the first machine (RB515) flying on April 2, 1945. The reason for the allocation of the mark number "XIV" to the first production variant of the Spiteful is somewhat obscure but appears to have stemmed from an early attempt to link the mark numbers of the new fighter to those of the equivalent Spitfires from which, at the



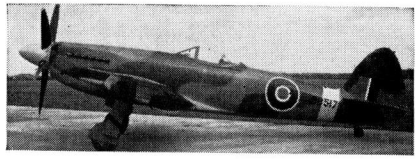
time, they stemmed. As at an early stage in the Spiteful's development it was anticipated that it would employ the Spitfire XIV fuselage (a standard Mk.VIII airframe suitably strengthened to take a Griffon 65 and its five-blade Rotol airscrew), the same mark number was allocated to the later fighter. Although, in the event, this scheme did not prove practicable, the mark number was retained.

The end of the war resulted in the cancellation of Spiteful production, and only some eight Spiteful XIVs were actually flown, although seventeen Spitefuls in all were completed, most of them being delivered to an R.A.F. maintenance unit by road and subsequently broken up.

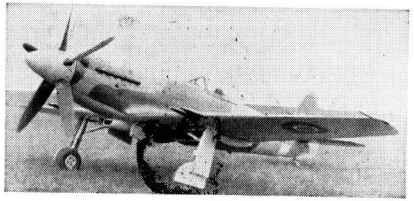
Parallel development of a navalised version of the fighter, the Type 382, had been undertaken, but it was not until May 1945 that this variant was ordered for the Fleet Air Arm, a contract being placed for 150 machines to specification N.5/45. In connection with this development programme, one Spiteful XIV (RB520) was fitted with an arrester hook for deck-landing trials. The navalised version was named Seafang but none flew before the end of the war. Two machines (VB893 and VB895) had originally been ordered as prototypes, and these were, in fact, the only fully navalized machines to be built, having folding outboard wing panels and Griffon 89 engines driving six-blade Rotol contra-rotating air-



(*Above*) *The first Spiteful XIV* (*RB*515), *and* (*below*) *the third Mk.XIV* (*RB*517).



(*Below*) *The fourth Spiteful XIV* (*RB*518).



screws and rated at 2,375 h.p. at 1,250 ft. This model, designated Type 396 Seafang 32, attained a maximum level speed of 475 m.p.h. at 21,000 ft., a range of 393 mls. at 230 m.p.h. at 20,000 ft. on internal tankage, and an initial climb rate of 4,630 ft./min. The Seafang 32s were preceded, however, by the pre-production Seafang 31s, ten of which were delivered (commencing VG471), the first of these flying on January 26, 1946. The Seafang 31, powered by the Griffon 61, was little more than a "hooked Spiteful", having non-folding wings, although a longer-stroke undercarriage was fitted, and the size of the fuselage fuel tank was reduced in order to provide space for cameras. With the completion of the ten Seafang 31s and eight Seafang 32s (six delivered in dismantled condition) the remainder of the production order was cancelled.

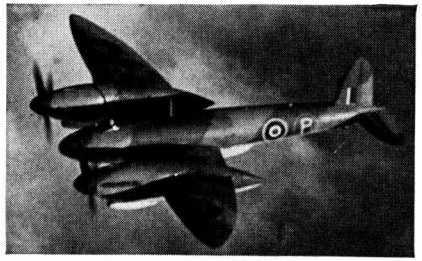
Despite the termination of Spiteful production, a certain amount of additional development on the design was undertaken. The Spiteful XV was a version with a similar engine and contra-rotating airscrews to those of the Seafang 32, and the definitive development, the Spiteful XVI, had a Griffon 101 three-speed blower engine. At Boscombe Down in 1947 the last-mentioned variant attained a speed of 494 m.p.h. at 28,500 ft., the highest level speed recorded by a British piston-engined machine and exceeded elsewhere only by the experimental XP-47J which achieved 504 m.p.h.

Type: *Single-seat Low- and Medium-altitude Day Fighter.* **Power Plant:** *One* 2,375 *h.p. Rolls-Royce Griffon* 69 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Four* 20-*mm. Hispano Mk.V cannon with* 167 *r.p.g. inboard and* 145 *r.p.g. outboard.* **Performance:** *Maximum speed,* 409 *m.p.h. at sea level,* 437 *m.p.h. at* 5,500 *ft.,* 483 *m.p.h. at* 26,000 *ft.; maximum cruising speed,* 385 *m.p.h. at* 20,000 *ft.; range* (*on internal fuel*), 564 *mls. at* 250 *m.p.h. at* 20,000 *ft.,* (*with two* 90 *Imp. gal. drop tanks*), 1,315 *mls.; initial climb rate,* 4,828 *ft./min.; time to* 20,000 *ft.,* 4.9 *min.; service ceiling,* 42,000 *ft.* **Weights:** *Empty,* 7,350 *lb.; loaded,* 9,950 *lb.; maximum,* 11,400 *lb.* **Dimensions:** *Span,* 35 *ft.* 0 *in.; length,* 32 *ft.* 11 *in.; height,* 13 *ft.* 5 *in.; wing area,* 210 *sq. ft.*

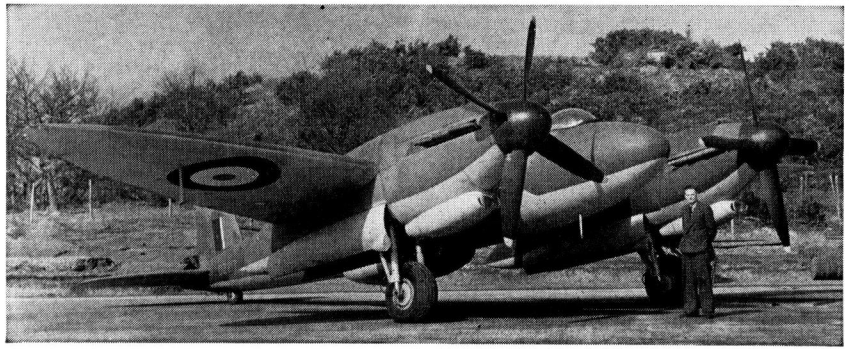
VICKERS 432 — GREAT BRITAIN

The possibility of Luftwaffe aircraft operating over the United Kingdom at altitudes beyond the capabilities of existing R.A.F. fighters began to assume the proportions of a serious threat during 1940, and the Air Ministry issued specifications calling for specialised high-altitude interceptors, pressurised cabins being prerequisites. Vickers tendered the Type 432 which, evolved from the earlier Type 414 project to specification F.22/39, met the requirements of specification F.16/40.

The responsibility of Dr. Barnes Wallis, the Type 432, which was at one time dubbed unofficially the "Mayfly" and was later revised in accordance with the demands of specification F.7/41, flew for the first time some seven weeks after the competitive Westland P.14 Welkin, during the last week of December 1942. Embodying a pressurization system similar to that evolved for the Wellington V and VI bombers, the Type 432 prototype (DZ217) had a relatively small, self-contained pressure cabin for the pilot whose head projected through a small, double-glazed dome or bubble which hinged to one side for



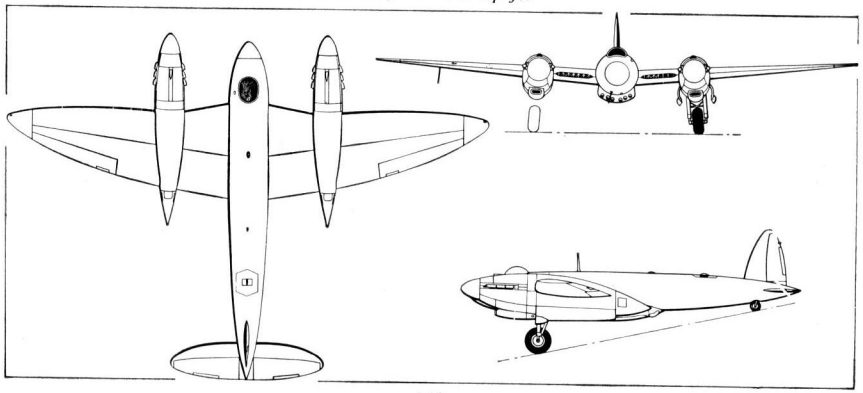
Only one prototype of the Vickers 432 *pressurized high-altitude interceptor was completed.*



entrance and exit. An all-metal monocoque stressed-skin fuselage was employed with two-spar wings, the forward portions of which had metal stressed-skinning and the aft portions fabric covering.

Initial trials proved the Type 432 to be difficult to handle on the ground, although it possessed an excellent performance once in the air, with a substantially higher maximum speed than that of the Welkin. Nevertheless, the Westland fighter was selected for production and most of the flight testing undertaken with the sole Type 432 fighter was concerned with assessing the aerodynamic efficiency of the wing structure. These trials continued until December 1944 when the machine was finally scrapped. The construction of a second prototype (DZ223) which had been ordered was abandoned.

Type: *Single-seat High-altitude Day Interceptor Fighter*. **Power Plants:** *Two* 1,520 *h.p. Rolls-Royce Merlin* 61 *twelve-cylinder Vee liquid-cooled engines*. **Armament** (*Proposed*): *Six* 20-*mm. Hispano Mk.I or II cannon with* 120 *r.p.g.* **Performance:** *Maximum speed*, 320 *m.p.h. at sea level*, 440 *m.p.h. at* 28,000 *ft.*, 400 *m.p.h. at* 40,000 *ft.*; *maximum cruising speed*, 400 *m.p.h. at* 29,500 *ft.*; *range*, 1,010 *mls. at* 30,000 *ft.*; *initial climb rate*, 2,750 *ft./min.*; *time to* 15,000 *ft.*, 5 *min.*; *to* 30,000 *ft.*, 10.6 *min.*; *service ceiling*, 43,500 *ft.* **Weights:** *Empty*, 12,143 *lb.*; *normal loaded*, 15,750 *lb.* **Dimensions:** *Span*, 57 *ft.* 6 *in.*; *length*, 40 *ft.* 8 *in.*; *height* (*tail up*), 13 *ft.* 10 *in.*; *wing area*, 441 *sq. ft.*



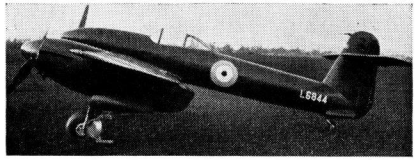
WESTLAND WHIRLWIND

GREAT BRITAIN

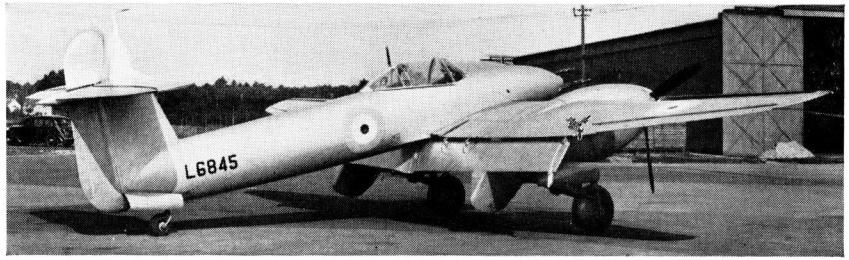
The R.A.F.'s first twin-engined single-seat fighter and the first such aircraft to be used in numbers by any of the belligerent powers, the Westland P.9 Whirlwind was designed in 1936 by W. E. W. Petter to the requirements of specification F.37/35. Of orthodox all-metal stressed-skin construction, the Whirlwind introduced several design innovations later to be widely adopted. For a twin-engined aircraft it was highly manoeuvrable; its handling characteristics were frequently referred to as delightful, and its performance at low altitudes was superior to that of contemporary single-engined fighters. Unfortunately, rather poor maintenance characteristics, continuous teething troubles suffered by its Peregrine geared and supercharged engines—which powered no other service type—and a high landing-speed which restricted the number of airfields from which it could operate, coupled with serious delays in engine deliveries, conspired to restrict the Whirlwind's career, and only two squadrons were equipped with the type.

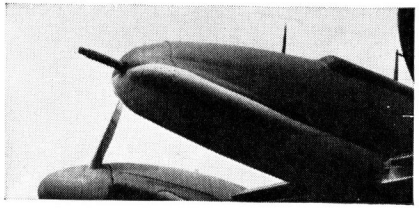
Conceived as a high-performance day and night fighter, with four cannon, the Whirlwind possessed an extremely slim fuselage, the cross-section of which was less than that of the engine nacelles. The four Hispano cannon were closely grouped in the fuselage nose to give a dense concentration of fire, and the all-round-vision cockpit canopy was an advanced feature. The coolant radiators were ducted within the centre-section of the wing, and Fowler-type flaps extended from aileron to aileron.

A contract for two prototypes (L6844 and L6845) was placed in February 1937, and the first of these flew on October 11, 1938. An



(*Above, right*) *The first prototype Whirlwind* (L6844) *and* (*below*) *the second prototype* (L6845).

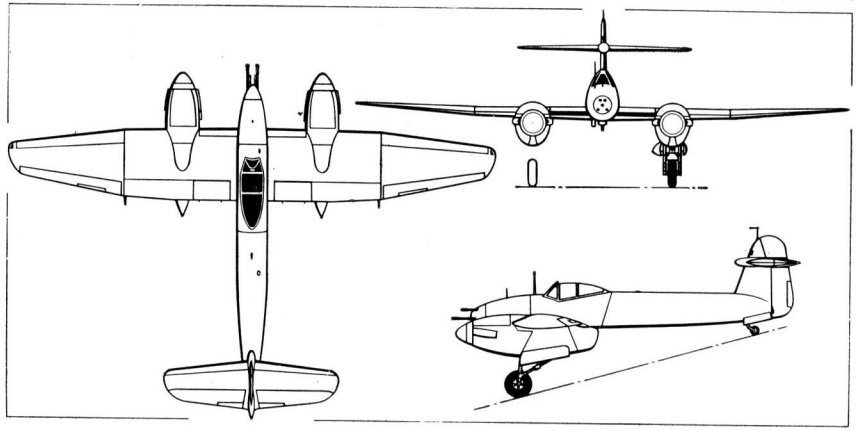


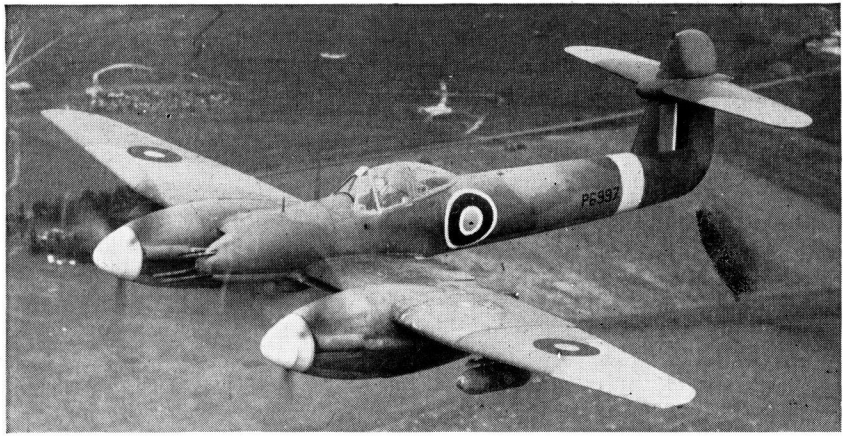


A 37-mm. cannon experimentally installed in the nose of a Whirlwind.

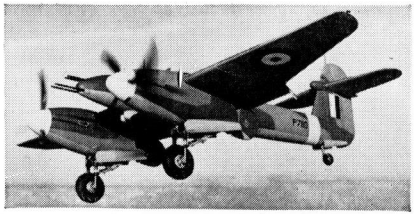
initial production order was placed in January 1939, deliveries being scheduled to commence during the following September. In the event the first Peregrines did not reach Westland until January 1940, and, in consequence, the first deliveries of the Whirlwind could not be made until June, 1940, and the fighter was issued to No. 263 Squadron which suffered a number of casualties as a result of accidents. It was not until November 1941 that a second squadron, No. 137, began to re-equip with the Whirlwind. No. 263 undertook a number of light day-bomber escort duties, the best-known of the operations undertaken by Whirlwinds of this squadron being the escort of six Blenheim squadrons as far as Antwerp on August 12, 1941. In the summer of 1942, the Whirlwinds of both squadrons were fitted with racks for two 250-lb. or 500-lb. bombs, and subsequently undertook low-level cross-Channel attacks on locomotives, bridges, shipping, harbour installations, and other targets until 1943 when both re-equipped with Typhoons.

One Whirlwind (P6972) underwent night-fighting trials in 1940 with No. 25 Squadron,





(Above) A Whirlwind (P6997) with 250-lb. bombs and (right) the 100th Whirlwind (P7110).



and at one period the first prototype (L6844) was fitted with twelve 0.303-in. Browning guns. Another Whirlwind was fitted experimentally with a single 37-mm. cannon. A total of 112 Whirlwinds was built for the R.A.F., the last machine (P7122) coming off the production line in January 1942.

Type: *Single-seat Escort Fighter and Fighter-bomber.* **Power Plants:** *Two* 885 *h.p. Rolls-Royce Peregrine twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano Mk.*1 *cannon plus two* 250-*lb. or* 500-*lb. bombs.* **Performance:** *Maximum speed,* 315 *m.p.h. at* 5,000 *ft.,* 334 *m.p.h. at* 10,000 *ft.,* 360 *m.p.h. at* 15,000 *ft.; initial climb rate,* 1,550 *ft./min.; climb rate at* 10,000 *ft.,* 3,000 *ft./min.; time to* 10,000 *ft.,* 4 *min., to* 20,000 *ft.,* 8.6 *min.; serv ce ceiling,* 30,000 *ft.* **Weights:** *Empty,* 7,840 *lb.; loaded (clean),* 10,385 *lb.; maximum,* 11,400 *lb.* **Dimensions:** *Span,* 45 *ft.* 0 *in.; length,* 31 *ft.* 6 *in.; height,* 10 *ft.* 10 *in.; wing area,* 250 *sq. ft.*

WESTLAND WELKIN

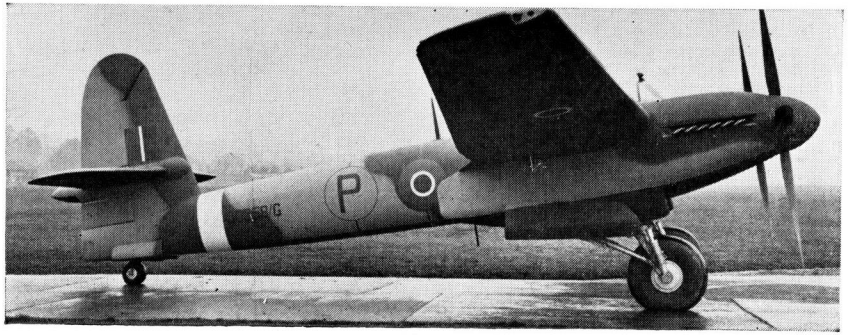
GREAT BRITAIN

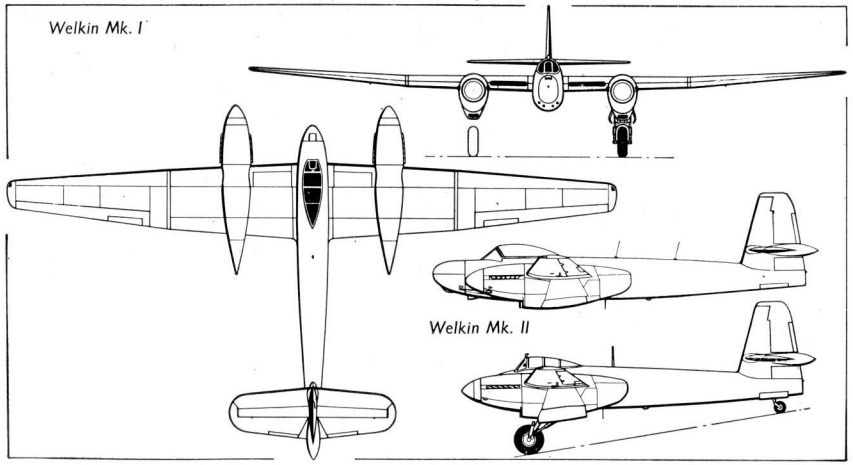
Early in 1940, the Air Ministry, foreseeing the possible need for a single-seat day and night fighter capable of attaining altitudes substantially greater than those within the capacity of existing fighters to combat possible stratospheric raids, issued specification F.4/40. This demanded a cannon-armed fighter to operate at 40,000 ft. and above, and to meet this requirement, W. E. W. Petter and his design team initiated work on the Westland P.14, later to be known as the Welkin.

The entire design emphasis was directed towards attaining the highest possible ceiling combined with the maximum possible speed, and preliminary investigations indicated the need for a high aspect ratio wing of inordinately large span. This subsequently characterized the design which was revised to accord with specification F.7/41, the first prototype (DG558/G) flying for the first time on November 1, 1942 with 1,290 h.p. Merlin 61 two-speed two-stage supercharged engines. The second prototype (DG562) which was similarly powered differed principally in having modified vertical tail surfaces but was later used for a series of trials in which liquid oxygen was injected into specially modified Merlins as a means of boosting power, particularly at high altitudes.

Production of the Welkin I fighter began early in 1943, the first aircraft (DX278) flying in September of that year, being followed by a further sixty-six machines. The Welkin I had a Merlin 72 or 76 in the starboard nacelle and a Merlin 73 or 77 in the port nacelle, the port engine driving the Rotol cabin supercharger. The pressure cabin was a self-contained unit constructed of extremely heavy gauge bullet-resisting light alloy and bolted to the front face of the main spar, with an

The first prototype Welkin (DG558) which was first flown on November 1, 1942 with Merlin 61s.

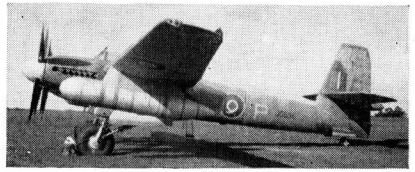


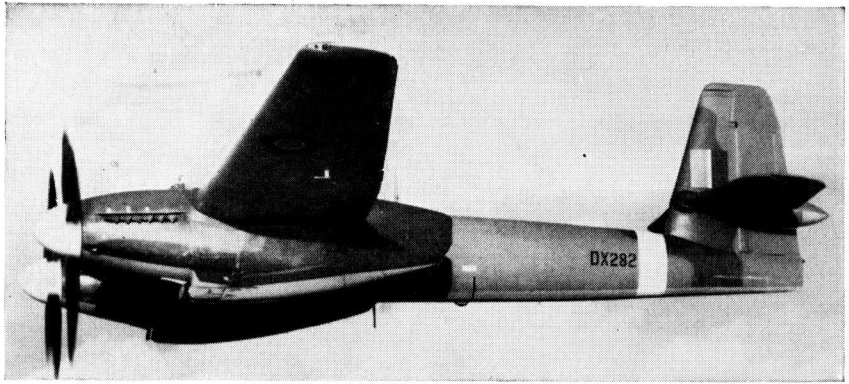


armour steel bulkhead at the rear, and a special openable bulkhead at the nose. The cabin was pressurised to the equivalent of 24,000 ft. at 45,000 ft. true altitude, and the sliding cockpit canopy was of hollow-sandwich type to facilitate de-icing and demisting. One Welkin I (DX340) was experimentally fitted with Merlin RM16SM engines, "beard" radiators supplanting the radiators normally mounted in the centre section between the fuselage and the nacelles. This experimental machine, which began its trials in modified form in June 1945, was somewhat faster than the standard Welkin I, attaining 398 m.p.h. at 30,000 ft.

As the anticipated high-altitude attacks failed to materialise, the Welkin I was never issued to a squadron, and with the completion of the sixty-seventh machine further production was cancelled. In October 1944, however, a two-seat night fighter development, the Welkin II (PF370, later re-serialled WE997),

The first prototype with long-range tanks.





(*Above*) *The fifth production Welkin I. A further sixty-one aircraft of this type were built.*

The sole prototype Welkin II (PF370 and later WE997).

had been flown. Basically similar to the Mk.I., the Welkin II had a lengthened nose to accommodate A.I. radar and dihedral on the outboard wing panels was increased by one-and-a-half degrees. The pilot's cockpit was moved forward, the front windscreen lowered, and a rearward-facing observer's seat incorporated. The sole Welkin II subsequently served as a radar test bed, but no further development was undertaken.

The specification relates to the Welkin I, figures in parentheses referring to the Welkin II.

Type: *Single-seat (Two-seat) High-altitude Day (Night) Interceptor.* **Power Plants:** *Two* 1,250 *h.p. Rolls-Royce Merlin* 76/77 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. Hispano cannon with* 480 *r.p.g.* **Performance:** *Maximum speed,* 387 (360) *m.p.h. at* 26,000 (30,000) *ft.,* 382 (330) *m.p.h. at* 40,000 *ft.; maximum climb rate,* 3,850 *ft./min.; time to* 10,000 *ft.,* 3.5 (3.7) *min., to* 20,000 *ft.,* 7.3 *min., to* 40,000 *ft.,* 20 *min.; service ceiling,* 44,000 (41,000) *ft.* **Weights:** *Empty,* 12,610 (15,635) *lb.; loaded,* 17,500 (21,892) *lb.* **Dimensions:** *Span,* 70 *ft.* 0 *in.; length,* 41 *ft.* 7 *in.* (44 *ft.* 1 *in.*); *height,* 15 *ft.* 9 *in.; wing area,* 460 *sq. ft.*

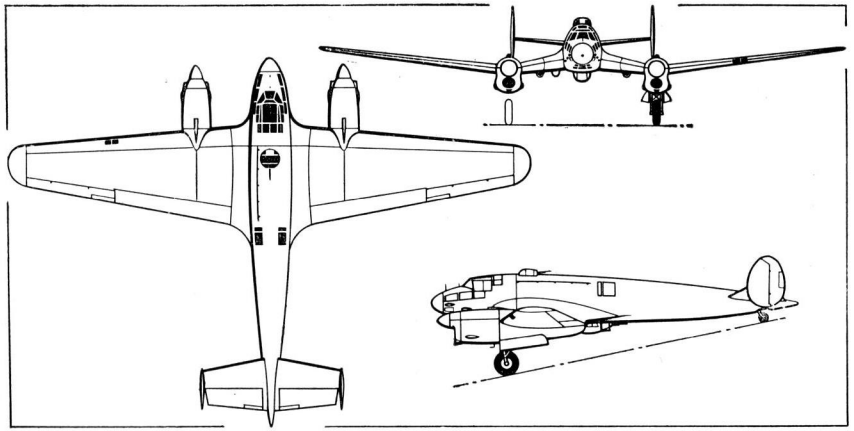
CAPRONI CA 331B RAFFICA

The Ca 331 Raffica (Squall) designed by Cesare Pallavicino of the Compania Aeronautica Bergamasca stemmed from a series of light twin-engined aircraft initiated by the Borea feederliner of 1935. The Raffica differed from its predecessors in supplanting the steel tube structure with ply and fabric covering with an all-metal stressed-skin structure—the first of its kind produced by the Bergamasca plant—and the first prototype was flown on August 31, 1940, as a light reconnaissance-bomber.

Possessing exceptionally clean lines, a sturdy structure and good handling qualities, the first prototype Raffica attained a maximum speed of 299 m.p.h. at 16,750 ft. during official trials at Guidonia on the power of two Delta R.C.40 engines rated at 770 h.p. at 13,120 ft. The prototype was also tested by the Luftwaffe at Rechlin, but owing to Italy's critical shortage of light alloys, no production order for the light bomber was placed on behalf of the Regia Aeronautica. By the autumn of 1942, however, the increasing menace of heavy Allied air attacks on Italian industry resulted in the decision to adapt the Raffica for the night-fighting role, and an order was placed for one thousand machines as the Ca 331b.

For the night-fighting role a new nose section was designed for the Raffica, total forward-firing armament being six 12.7-mm. SAFAT machine guns. By August 1943, one of the two Ca 331b prototypes had been tested with a forward-firing armament of two 12.7-mm. guns and four 20-mm. Mauser cannon, the other having a ventral tray housing six Ikaria cannon which, of similar calibre, were smaller and lighter than the Mauser cannon. In addition to night fighting, the Ca 331b could be used for assault and torpedo-dropping roles. A jettisonable fuel tank or a 220-lb. bomb could be carried under each wing, and a small bomb bay was provided which could accommodate 2,200 lb. of small bombs or a 110 Imp. gal. auxiliary fuel tank. Armour protection (6-mm. and 8-mm.) was provided for the three crew members.

By September 8, 1943, when Italy capitulated, preparations for quantity production had reached an advanced stage. The engine nacelles, undercarriage and rear fuselage were being



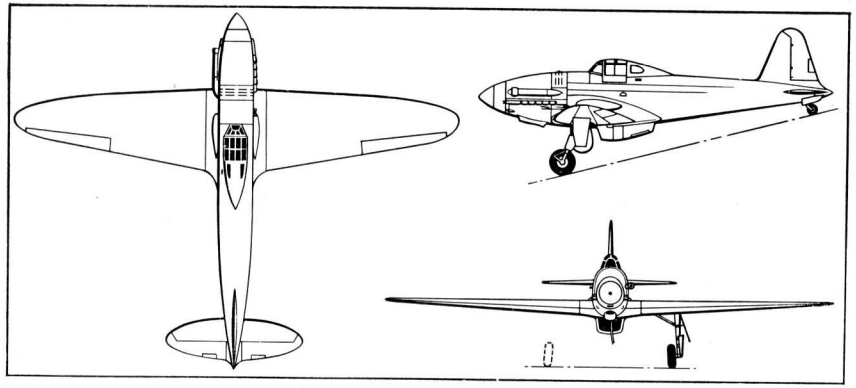
manufactured at Ponte San Pietro; the wings were being manufactured by Reggiane at Reggio Emilia; the tail assembly was being produced by the Caproni factory at Trento, and various other plants were supplying components. Proposals had been made for a tank-busting variant with a 37-mm. cannon in a ventral fairing, and consideration was given to the installation of the 1,475 h.p. Fiat R.A.1050 R.C.58 Tifone (DB 605A-1) liquid-cooled engine in place of the air-cooled Delta IV. With the more powerful engines, speeds of up to 400 m.p.h. could have been attained by the fighter. With the Armistice the two Ca 331b Raffica prototypes were seized by the Germans and, eventually, dismantled and scrapped, and tooling for the production model was never completed.

Type: *Three-seat Night Fighter.* **Power Plants:** *Two* 840 *h.p. Isotta-Fraschini Delta IV twelve-cylinder inverted-Vee air-cooled engines.* **Armament:** *Two* 12.7-*mm. SAFAT machine guns and four* 20-*mm. Mauser MG* 151 *cannon or six* 20-*mm. Ikaria cannon firing forward, and one hand-operated* 12.7-*mm. SAFAT machine gun in each of the dorsal and ventral positions.* **Performance:** *Maximum speed,* 255 *m.p.h. at sea level,* 314 *m.p.h. at* 17,400 *ft.; maximum cruising speed,* 280 *m.p.h. at* 5,600 *ft.; range,* 994 *mls. at* 248 *m.p.h.,* 1,125 *mls. at* 199 *m.p.h.; maximum endurance,* 5 *hr.* 40 *min.; climb to* 13,120 *ft.,* 9 *min.* 35 *sec., to* 19,680 *ft.,* 14 *min.* 50 *sec.; service ceiling.* 26,550 *ft.* **Weights:** *Empty,* 10,140 *lb.; normal loaded,* 14,992 *lb.* **Dimensions:** *Span,* 53 *ft.* 10 *in.; length,* 38 *ft.* 6½ *in.; wing area,* 414.44 *sq. ft.*

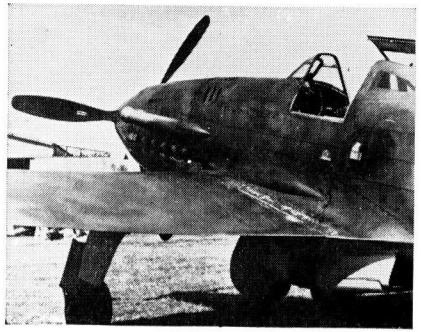
CAPRONI VIZZOLA F.4

The Caproni Vizzola S.A. of Vizzola Ticino, Varese, was originally one of the oldest flying schools in Italy, the Scuola di Aviazionie Caproni, expanding its activities into the field of aircraft construction in the mid-'thirties, and initiating a programme of original design development in 1938 under the direction of Ing. Fabrizi. Work on two single-seat interceptor fighters, the F.4 and F.5, was started, and development of the machines proceeded in parallel. The two fighters employed similar airframes, differing principally in the type of power plant installed, the F.4 having a twelve-cylinder upright-Vee liquid-cooled Isotta-Fraschini Asso 121 R.C.40 rated at 890 h.p. for take-off and giving 960 h.p. at 13,120 ft., and the F.5 employing a fourteen-cylinder two-row radial air-cooled Fiat A.74 R.C.38 rated at 870 h.p. for take-off and 840 h.p. at 12,500 ft.

At a late stage in the construction of the F.4 prototype, the decision was taken to install the German Daimler-Benz DB 601A engine in place of the lower-powered Asso 121, this change inevitably delaying the flight test programme which did not commence until 1940. The F.4 was of mixed construction, the wing being a wooden two-spar structure with stressed plywood skin, the fuselage being an oval welded steel-tube structure with flush-riveted duralumin skinning, and the tail assembly comprising a duralumin framework



with metal-covered fixed surfaces and fabric-covered rudder and elevators. All three members of the hydraulically-operated undercarriage were fully retractable.



Although the F.4 possessed excellent manoeuvrability and handling characteristics, no production was undertaken, Ing. Fabrizi deciding to develop the basic design further as the F.6 with the more powerful DB 605 engine.

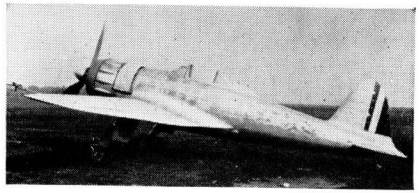
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,175 *h.p. Daimler-Benz DB* 601*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. SAFAT machine guns mounted above the wing roots.* **Performance:** *Maximum speed,* 342 *m.p.h. at* 12,500 *ft.; maximum cruising speed,* 304 *m.p.h.; range at economical cruising speed,* 435 *mls.; service ceiling,* 32,800 *ft.* **Weights:** *Loaded,* 6,614 *lb.* **Dimensions:** *Span,* 37 *ft.* 0⅞ *in.; length,* 29 *ft.* 2⅓ *in.; height,* 9 *t.* 6⅛ *in.; wing area,* 189.44 *sq. ft.*

CAPRONI VIZZOLA F.5

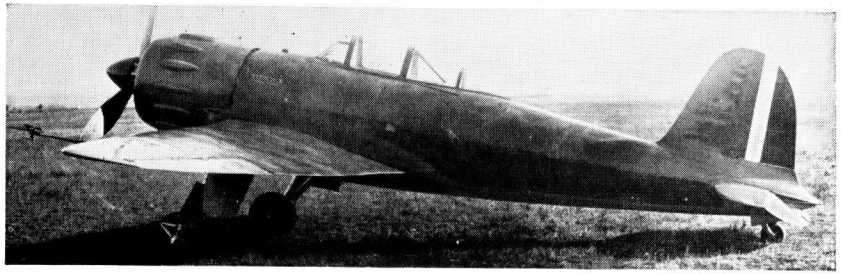
Developed in parallel with the Caproni Vizzola F.4, the prototype F.5 actually preceded the fighter possessing the earlier designation, commencing flight trials during the early months of 1939, and competing with the Fiat G.50 and Macchi C.200 for production orders. The prototype embodied several advanced features, including a variable-incidence tailplane and ailerons which automatically drooped ten degrees with the extension of the flaps to increase the lift coefficient and improve lateral stability at approach speeds. The structure of the F.5 was identical to that of the parallel F.4.

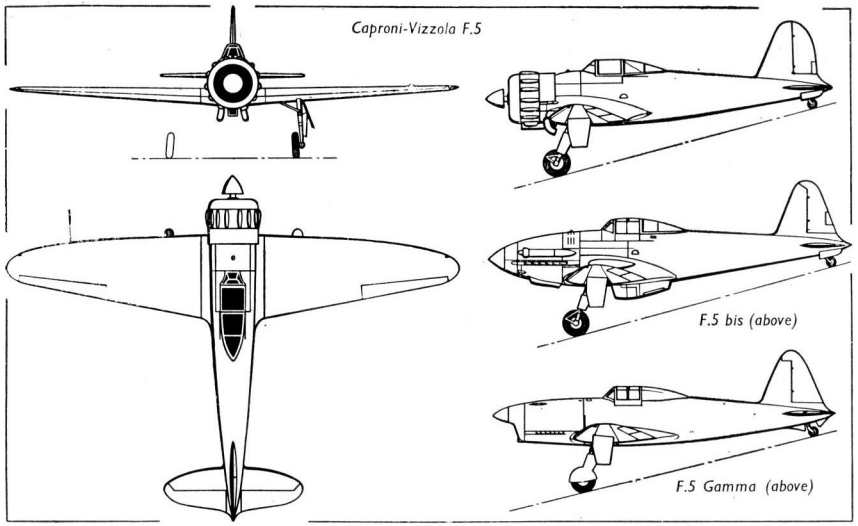
A pre-production batch of fourteen machines was ordered by the Italian Air Ministry, the first of these being completed at the beginning of 1940. The pre-production model differed from the prototype in having an enlarged and redesigned fin-and-rudder assembly to rectify some instability experienced during initial trials, provision for an auxiliary fuel tank in the fuselage, a different cockpit canopy, and a non-retractable tailwheel. The pre-production machines were delivered to a Squadriglia based at Ciampino and assigned to the night defence of Rome.

Several developments of the basic design were proposed by Ing. Fabrizi, including the F.5bis which was to have been fitted with a 1,175 h.p. Alfa Romeo R.A.1000 R.C.44-1a Monsonie (Monsoon) engine (a licence-built



(Above, right) The prototype Caproni Vizzola F.5 and (below) one of the fourteen pre-production aircraft.





version of the DB 601A-1). Single- and two-seat advanced training variants powered by the 540 h.p. Isotta-Fraschini Gamma R.C.35 IS air-cooled engine were also proposed, these employing the same wings, undercarriage and tail assembly as the basic F.5 fighter married to a new fuselage. A single 7.7-mm. SAFAT machine gun was to have been carried with 400 rounds, and the single-seat model had an estimated maximum speed of 254 m.p.h. at 14,764 ft.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 870 *h.p. Fiat A.*74 *R.C.*38 *fourteen-cylinder two-row radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. SAFAT machine guns.* **Performance:** *Maximum speed,* 317 *m.p.h. at* 9,840 *ft.,* 299 *m.p.h. at* 14,764 *ft.; climb to* 21,325 *ft.,* 6.5 *min.; ceiling,* 31,170 *ft.; normal range,* 478 *mls. at* 283 *m.p.h. at* 18,045 *ft.; maximum range, (with auxiliary fuel tank)* 620 *mls.; normal endurance,* 1 *hr.* 53 *min.* **Weights:** *Empty,* 4,078 *lb.; loaded,* 5,181 *lb.* **Dimensions:** *Span,* 37 *ft.* 0⅞ *in.; length,* 25 *ft.* 11 *in.; height,* 9 *ft.* 10 *in.; wing area,* 189.44 *sq. ft.*

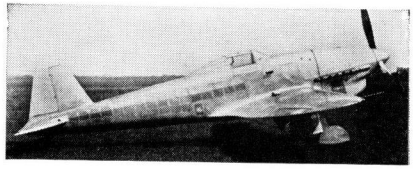
CAPRONI VIZZOLA F.6

ITALY

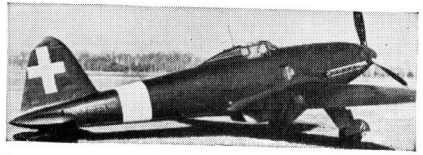
The last fighter to be built to the designs of Ing. Fabrizi was the Caproni Vizzola F.6, a progressive development of the F.4 and F.5 fighters. The prototype F.6 was produced by installing a Daimler-Benz DB 605A engine rated at 1,475 h.p. in an F.5 airframe, this engine later being manufactured under licence in Italy as the Fiat R.A.1050 R.C.58 Tifone (Typhoon). The mixed structure of the F.5 was retained by the prototype, but further prototypes were built under the designation F.6M, the "M" suffix indicating all-metal construction.

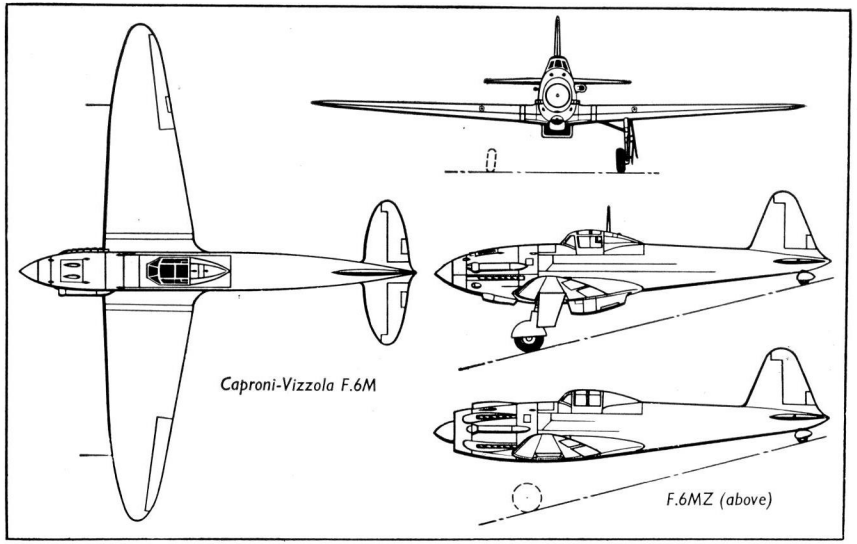
Principal development of the design was towards the installation of the twenty-four-cylinder X-type Isotta-Fraschini Zeta R.C.35 which had commenced bench-testing on February 28, 1941, offering 1,150 h.p. at 2,700 r.p.m. This engine was considered unsuitable for fighter installation in its original form owing to its inadequate output at altitude, development resulting in the pre-production Zeta R.C.42 with improved altitude capability. Two further versions of the Zeta were produced, the R.C.50-SD with a single-speed Isotta-Fraschini compressor and giving an emergency power rating of 1,350 h.p., and the R.C.25/60 with a Wright-type two-speed compressor. The last-mentioned version of the Zeta was test run on May 8, 1943, and, rated at 1,200 h.p. at 19,685 ft., had already been placed in production for use by the Caproni Vizzola F.6MZ and the Reggiane Re 2004 fighters.

Preparations for a pre-production batch of Zeta-engined F.6MZ fighters were being made and tests with a prototype F.6MZ had commenced when, on September 8, 1943, the Armistice brought the development programme to a halt. At this time, one further development of the Fabrizi series of fighters was under active development, the F.7, this being an exceptionally clean aircraft of light construction powered by an Alfa Romeo R.C. 44-1a Monsonie (DB 601A-1) engine. The wings and tail were essentially similar to those of the F.6, but the cross-section of the fuselage was substantially reduced, and armament comprised one 20-mm. Mauser MG 151 cannon and two 12.7-mm. SAFAT machine guns. Estimated performance included a maximum speed of 373 m.p.h. at 18,370 ft., a range of 777 mls. at 300 m.p.h. at 19,685 ft.,



(Above) F.6M with original radiator and (below) finalised arrangement.





and the ability to climb to 13,125 ft. in 3 min. 40 sec.

The following specification relates to the F.6M, figures in parentheses relating to the F.6MZ.

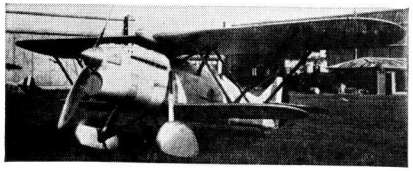
Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,475 *h.p. Fiat R.A.*1050 *R.C.*58 *Tifone twelve-cylinder inverted-Vee liquid-cooled engine* (*One* 1,250 *h.p. Isotta-Fraschini Zeta R.C.*25/60 *twenty-four-cylinder X-type air-cooled engine*). **Armament:** *Four* 12.7-*mm. SAFAT machine guns with* 400 *r.p.g.* (*Two* 12.7-*mm. and two* 7.7-*mm. SAFAT machine guns*) **Performance:** *Maximum speed,* 353 (404) *m.p.h. at* 16,400 (19,685) *ft.; maximum cruising speed,* (367) *m.p.h.; economical cruising speed,* 296 (248) *m.p.h.; range,* 590 (851) *mls. at* 19,685 *ft.; time to* 19,685 *ft.,* 5.5 *min.; service ceiling,* 34,450 (26,250) *ft.; endurance,* 2.05 (2.75) *hrs.* **Weights:** *Empty,* 7,382 *lb.; loaded,* 9,432 (9,022) *lb.* **Dimensions:** *Span,* 37 *ft.* 0⅞ *in.* (38 *ft.* 9⅓ *in.*); *length,* 30 *ft.* 0¼ *in.* (29 *ft.* 6¾ *in.*); *height,* 9 *ft.* 10⅝ *in.; wing area,* 189.44 *sq. ft.*

FIAT C.R.32

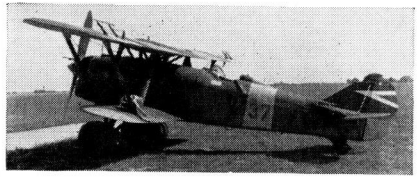
Although totally obsolete by international standards appertaining at the time, the Fiat C.R.32 was the most important single-seat fighter serving with the Regia Aeronautica in the autumn of 1939, some four hundred aircraft of this type being included in the first-line strength, 294 of these equipping squadrons based in Metropolitan Italy. By the time Italy entered World War II, the C.R.32 had been largely relegated to second-line units and training establishments, but the type nevertheless saw some operational service, notably in the night-fighting and close-support roles.

Designed by Ing. Celestino Rosatelli and flown for the first time in 1933, the C.R.32 was essentially a refinement of the C.R.30 which had appeared in the previous year, and was an unequal span biplane with Warren-type interplane bracing, employing light alloy and steel construction with fabric covering. Armament comprised two 12.7-mm. Breda-SAFAT machine guns, and more than 350 fighters of this type were produced before it was supplanted in 1935 by the more heavily armed C.R.32bis. The twin 12.7-mm. guns in the top cowling were supplemented by twin 7.7-mm. guns mounted inboard on the lower wings, and a rack was provided beneath the fuselage for a 220-lb. bomb or two 110-lb. bombs. More than three hundred C.R.32bis fighters were produced and, in August 1936, the first aircraft of this type arrived in Spain for the Squadriglia "La Cucaracha" of the Aviación Legionaria, the Italian force sent to assist General Franco's forces. Several C.R.32bis-equipped Italian Stormi fought over Spain; the type was supplied to the Spanish Nationalist government, and was also exported to China, Hungary, Paraguay and Venezuela.

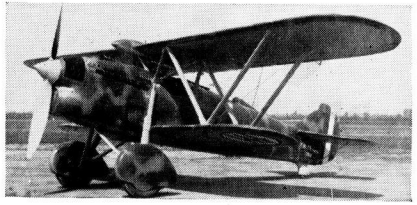
The C.R.32ter introduced in 1936 differed in minor respects and embodied some modifications to the undercarriage, and after the completion of about one hundred fighters of this type, the definitive production model, the C.R.32quater, appeared. This continued in production until the autumn of 1939, bringing

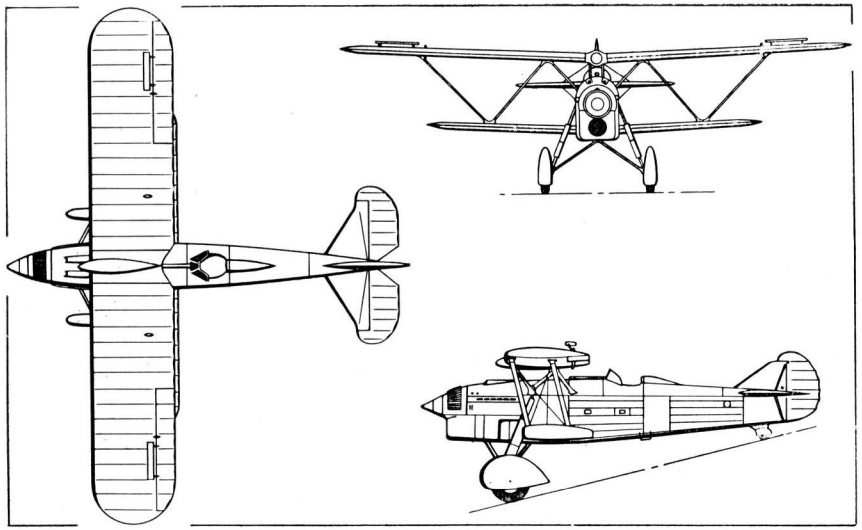


(*Above*) *The C.R.32bis with four-gun armament.*



(*Above*) *A C.R.32quater of the Hungarian Air Force and* (*below*) *a Regia Aeronautica C.R.* 32*quater.*





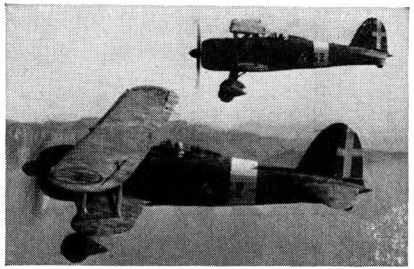
total production of all variants of the C.R.32 to 1,212 machines. The C.R.32quater reverted to the original armament of two 12.7-mm. guns, and some machines were fitted with exhaust shrouds, etc., to serve as night fighters. In 1938 the licence manufacture of the C.R.32-quater was initiated in Spain by Hispano-Suiza as the HA-132-L Chirri.

Type: *Single-seat Interceptor and Close-support Fighter.* **Power Plant:** *One* 600 *h.p. Fiat A* 30 *R.A.bis twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 375 *r.p.g. plus twelve* 4.4-*lb. anti-personnel bombs.* **Performance:** *Maximum speed,* 221 *m.p.h. at* 9,840 *ft.,* 205 *m.p.h. at sea level; cruising speed,* 196 *m.p.h. at* 15,750 *ft.; range,* 485 *mls.; time to* 3,280 *ft.,* 1 *min.* 30 *sec., to* 9,840 *ft.,* 5 *min.* 10 *sec., to* 16,400 *ft.,* 10 *min.; service ceiling,* 25,750 *ft.* **Weights:** *Empty,* 3,042 *lb.; loaded,* 4,200 *lb.* **Dimensions:** *Span,* 31 *ft.* 2 *in.; length,* 24 *ft.* 5⅜ *in.; height,* 8 *ft.* 11 *in.; wing area,* 237.882 *sq. ft.*

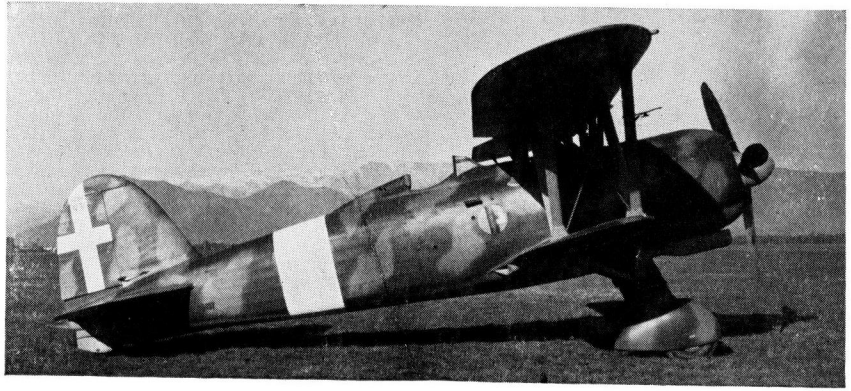
FIAT C.R.42 FALCO

The C.R.42 Falco designed by Ing. Celestino Rosatelli possessed the dubious distinction of being the last single-seat fighter biplane to be manufactured by any of the combatants. A progressive development of the experimental C.R.41 of 1936, the C.R.42 began to leave the assembly line in 1939, by which time other nations had abandoned the further development of the fighter biplane in favour of the fighter monoplane. The C.R.42 employed the Warren-type interplane bracing that had characterised previous Rosatelli fighter designs, but featured a number of technical improvements, making considerable use of high-value materials, such as manganese and molybdenum steels. The fuselage was a welded steel-tube triangulated structure faired to an oval section and covered with metal panels forward and fabric aft, while the unequal-span rigidly-braced wings were of light alloy and steel construction with fabric covering.

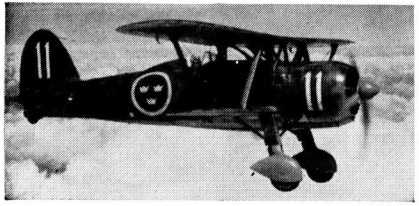
The prototype C.R.42, which flew early in



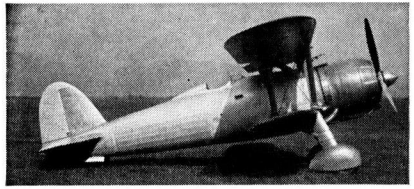
(*Right*) *Standard C.R.*42 *fighters and* (*below*) *the C.R.*42-*A.S. fighter-bomber.*



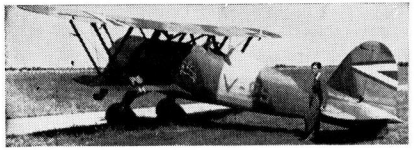
1939, differed little from the initial production model, apart from having a fully-retractable tailwheel, that of the production C.R.42 being fixed and enclosed by an aerodynamic fairing which castered with the wheel. Early production machines carried an armament of one 7.7-mm. and one 12.7-mm. gun, but the C.R.42bis carried two 12.7-mm. guns, while the C.R.42ter carried an additional pair of 12.7-mm. guns in fairings under the lower wing.



One of seventy-two Swedish C.R.42 fighters.



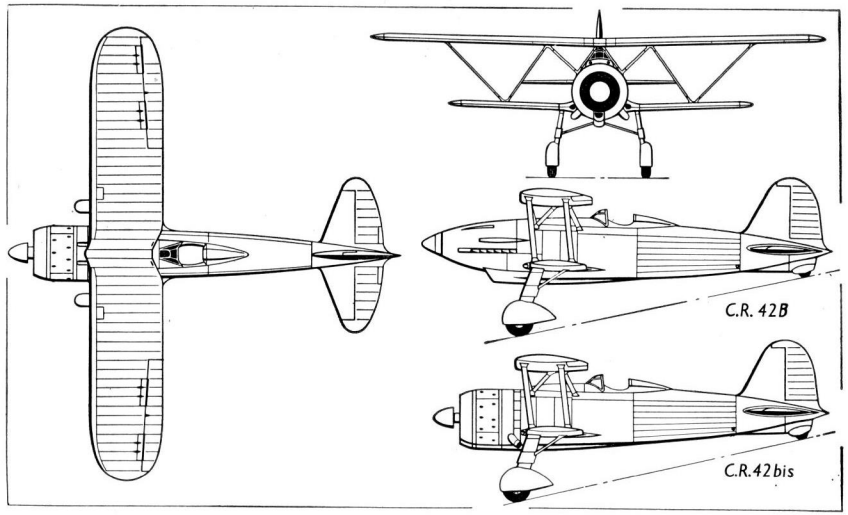
(Above) The prototype C.R.42 with retractable tailwheel and (below) a Hungarian C.R.42.



The Hungarian Air Force was the first foreign purchaser of the C.R.42, obtaining a number of fighters of this type during the late months of 1939, these subsequently being employed primarily in the home-defence role. In September 1939 the Belgian government placed an order for thirty-four C.R.42s, the first of which reached Belgium on March 6, 1940, entering service with the 3*ème Escadrille de Chasse* which unit had twenty-five C.R.42s on May 10, 1940. Thirteen of these were destroyed by Ju 87B dive-bombers during the first Luftwaffe aerial attack, and the survivors played little part in the fighting over Belgium. The Swedish government ordered seventy-two C.R.42s which were delivered to the Flygvapnet in 1940, these being powered by Nohab-built Mercury VIIIs.

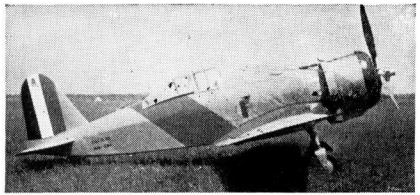
The Regia Aeronautica's C.R.42s joined combat in June 1940 with Dewoitine D.520s of the Armée de l'Air, and participated in a few attacks on the British Isles made by the Corpo Aereo Italiano in October and November 1940. Subsequently the C.R.42 was widely used as a bomber escort over the Mediterranean and North Africa, but as the fighter's relatively low performance rendered it increasingly unsuited for this role, it was relegated to night-fighting duties in Italy, and to the fighter-bomber role in North Africa. As a fighter-bomber, the Falco was designated C.R.42-A.S. and carried two 220-lb. bombs on underwing racks. The streamlined fairings enclosing the mainwheels were usually removed.

In 1940, the Construzioni Meccaniche Aeronautique S.A. produced an experimental twin-float seaplane version of the Falco, the I.C.R.42, and in 1941 the C.R.42B appeared with a

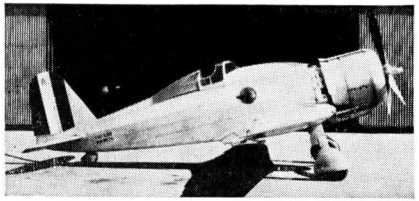


1,010 h.p. Daimler-Benz DB 601 liquid-cooled engine. The C.R.42B attained a maximum speed of 323 m.p.h., no mean achievement for a biplane, but by this time even the Italians admitted that the heyday of the biplane had long passed, and only one prototype C.R.42B was constructed. When production of the C.R.42 finally terminated in 1942, 1,781 aircraft of this type had been built.

Type: *Single-seat Fighter Biplane.* **Power Plant:** *One* 840 *h.p. Fiat A* 74 *R.C.*38 *fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 400 *r.p.g.* **Performance:** *Maximum speed,* 244 *m.p.h. at* 6,560 *ft.,* 256 *m.p.h. at* 9,840 *ft.,* 266 *m.p.h. at* 13,120 *ft.; normal range (internal fuel),* 488 *mls. at* 214 *m.p.h. at* 19,685 *ft. (with* 22 *Imp. gal. auxiliary fuel),* 630 *mls.; time to* 9,840 *ft.,* 3 *min.* 53 *sec., to* 13,120 *ft.,* 5 *min.* 26 *sec., to* 16,400 *ft.,* 7 *min.* 5 *sec.; service ceiling,* 33,300 *ft.* **Weights:** *Empty,* 3,763 *lb.; normal loaded,* 5.042 *lb.; maximum,* 5,302 *lb.* **Dimensions:** *Span,* 31 *ft.* 9¾ *in.; length,* 27 *ft.* 2¾ *in.; height,* 10 *ft.* 9⅞ *in.; wing area,* 240.573 *sq. ft.*



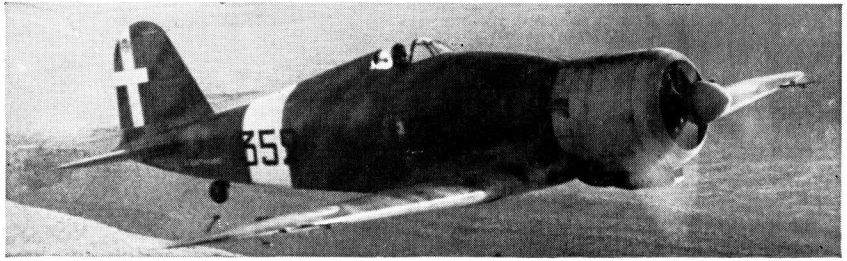
(Above) The first prototype G.50 (MM 334) and (below) the fifth production G.50 Freccia.

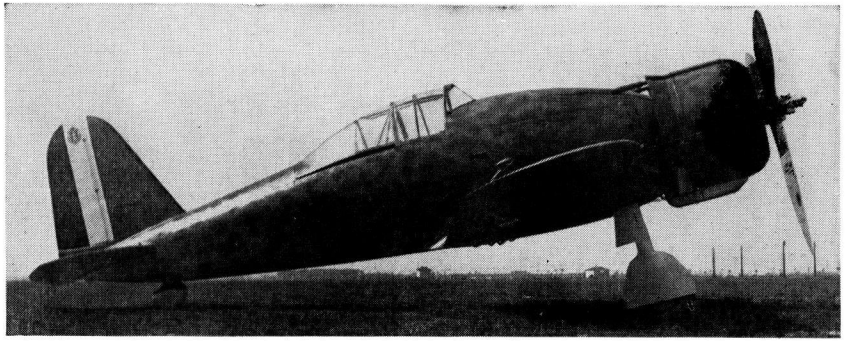


The G.50 Freccia (Arrow), designed by Ing. Giuseppe Gabrielli, was the first all-metal single-seat fighter monoplane designed and flown in Italy. Developed to meet the requirements of a specification prepared in 1936 by the Italian Air Ministry which also resulted in the Macchi C.200, the Caproni Vizzola F.5, the I.M.A.M.Ro.51, the Reggiane Re.2000, and the A.U.T.18, the first prototype G.50 (MM 334) was flown for the first time on February 26, 1937. A low-wing cantilever monoplane, the G.50 had an all-metal monocoque fuselage with a three-piece wing, the centre section of welded steel-tubes and the outer sections having duralumin spars with metal skinning. The moveable control surfaces were fabric covered, and statically and aerodynamically balanced, and split flaps were fitted.

An initial production batch of forty-five G.50 Freccia fighters (commencing MM 3570) was built, and twelve of these were sent to Spain in 1938 for testing under operational conditions with the Gruppo Caccia Sperimen-

The G.50bis Freccia (below) was one of the most important Regia Aeronautica fighters.

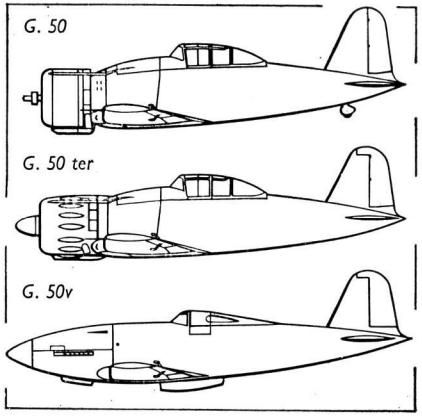


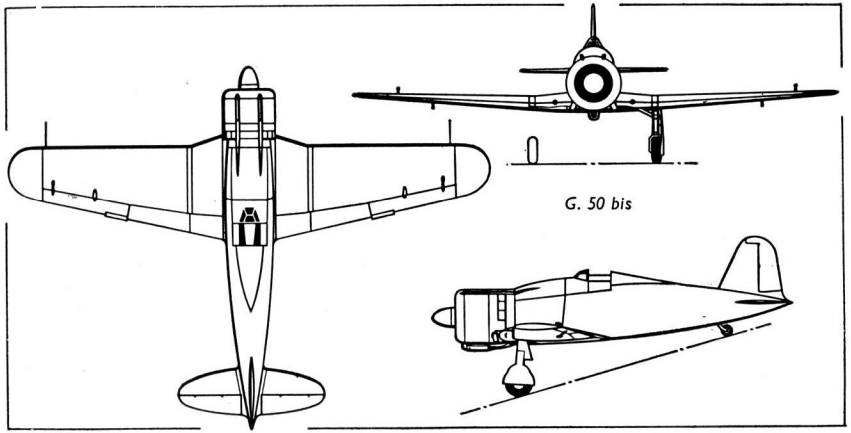


The first production G.50 (MM 3570). Forty-five were built with enclosed cockpits.

tale. The successful results of these trials led to an order for a further 200 G.50s, but the sliding cockpit canopy fitted to the initial batch of machines was deleted as this feature was disliked by service pilots. The fifth production aircraft (MM 3574) was used for trials with various types of semi-enclosed cockpits, that eventually adopted having folding Perspex flaps on each side of the cockpit to prevent the slipstream buffeting the pilot. In 1939, thirty-five G.50 fighters were ordered by the Finnish government, but these were detained by the German government while en route to Finland, eventually entering service with the Finnish Air Force's No. 26 Squadron in 1940, after the cessation of fighting between Finland and the Soviet Union, and continuing in first-line service until May 1944 when they were relegated to the training role.

When Italy entered the war on June 10, 1940, one fighter group of the Regia Aeronautica was equipped with the G.50, and



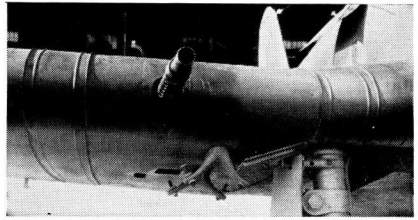


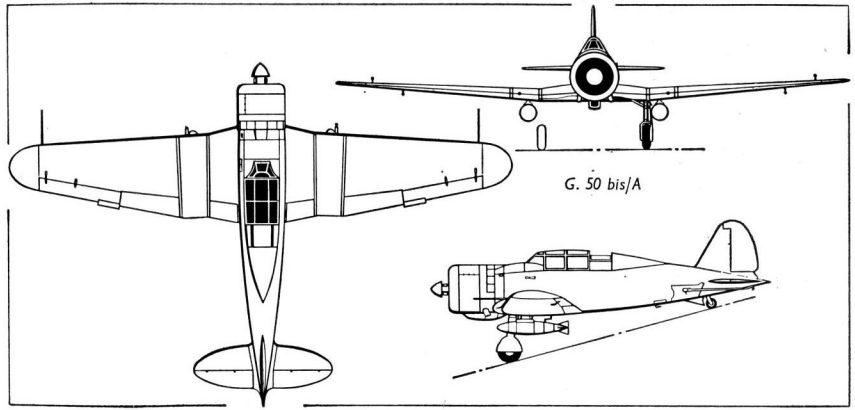
forty-eight of these (from the 20° Gruppo Caccia Terrestre) accompanied the Corpo Aereo Italiano which arrived in Belgium in October 1940. The G.50s were based at Ursel for a brief period but there is no record of them having been encountered in action over the British Isles.

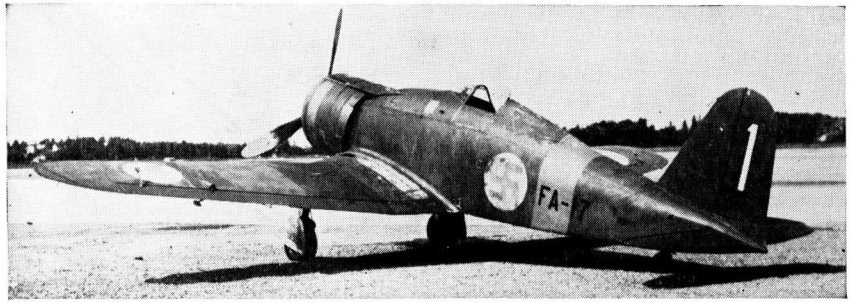
An unarmed tandem two-seat training variant of the Freccia, the G.50B, was flown for the first time on April 30, 1940 (MM 3615), one hundred aircraft of this type being subsequently built, and on September 9, 1940, a new fighter version, the G.50bis, was flown for the first time. The G.50bis differed from the G.50 in several respects. The special internal bay for 2.2-lb. anti-personnel or incendiary bombs featured by the G.50 was supplanted in the G.50bis by a 25 Imp. gal. fuel tank; the forward spar in the centre-section which had been built in one piece in the G.50 was replaced by a new three-piece spar; the Messier undercarriage was replaced by a Magnaghi unit; the tailwheel fairing was eliminated, and the vertical tail surfaces were redesigned, being of reduced height and increased chord. The last mentioned change resulted in an increase in overall length from 26 ft. 4 in. to 27 ft. 2⅓ in., and a reduction in height from 10 ft. 9 in. to 9 ft. 2¼ in. The wing span remained the same at 36 ft. 0⅞ in. but empty and loaded weights were increased from 4,328 lb. to 4,442 lb., and from 5,295 lb. to 5,560 lb. respectively. Four hundred and fifty G.50bis fighters were built and ten of these were supplied to the Croatian Air Force.

The G.50 Freccia had seen action with the 2° Gruppo Caccia Terrestre over Greece from October 1940, and the G.50bis was subsequently employed widely by the Regia Aeronautica in North Africa, but the fighter possessed inadequate firepower and most pilots preferred the contemporary Macchi C.200. Various attempts were made to improve the performance of the Freccia by substituting more powerful engines for the Fiat A.74 R.C.38. The first of these experimental models was the G.50ter which flew on July 17, 1941 with a 1,000 h.p. Fiat A.76 R.C.40. The G.50ter attained a maximum speed of 329 m.p.h., but development of the A.76 engine had already been abandoned before flight trials with the experimental machine began, and no further development of the G.50ter was undertaken. A Fiat subsidiary, Construzioni Meccaniche Aeronautique S.A. at Marina di Pisa which had been responsible for the development of the G.50B trainer, undertook the installation of a 1,050 h.p. Daimler-Benz DB 601A engine in a G.50 airframe. This conversion, designated G.50V, was flown for the first time on August 25, 1941, and attained 360 m.p.h. during trials. A projected production version of the G.50V with a DB 601N

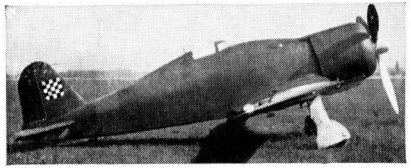
A close-up of the extra wing section of the G.50bis/A.







(*Above*) *One of thirty-five G.50s delivered to Finland in* 1940 *and* (*below, left*) *one of ten Croatian G.50bis fighters.*



engine was designated G.52, but this was abandoned in favour of the more extensively redesigned G.55 Centauro. Another variant which remained in the project stage was the G.52 with a Fiat A.75 R.C.53 engine.

The last variant of the Freccia developed was the G.50bis/A two-seat fighter-bomber, the sole example of which flew on October 3, 1942. Additional sections were inserted in the wings outboard of the centre section. These sections, which each housed a single 12.7-mm. Breda-SAFAT machine gun with 250 r.p.g. (increasing total armament to four 12.7-mm. guns), and carried shackles for a pair of 353-lb. bombs, increased overall span to 40 ft. 7⅛ in. An arrester hook was provided to suit the G.50bis/A for operation from the carriers *Aquila* and *Sparviero* which were, at that time, being converted from merchantmen, and, with empty and loaded weights of 5,110 lb. and 7,359 lb. respectively, the fighter-bomber's performance included a maximum speed of 263 m.p.h., a service ceiling of 27,890 ft., and a range of 620 miles.

The specification relates to the G.50bis.

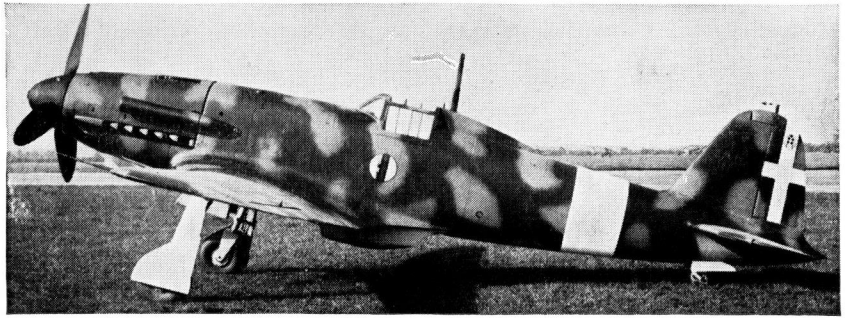
Type: *Single-seat General-purpose Fighter.* **Power Plant:** *One* 840 *h.p. Fiat A.*74 *R.C.*38 *fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 300 *r.p.g.* **Performance:** *Maximum speed,* 293 *m.p.h. at* 16,400 *ft.; cruising speed* (70% *power*), 258 *m.p.h.; maximum range,* 620 *mls.; climb to* 16,400 *ft.,* 8 *min.; service ceiling,* 32,480 *ft.* **Weights:** *Empty,* 4,442 *lb.; loaded,* 5,560 *lb.* **Dimensions:** *Span,* 36 *ft.* 0⅞ *in.; length,* 27 *ft.* 2⅛ *in.; height,* 9 *ft.* 2¼ *in.; wing area,* 196.44 *sq. ft.*

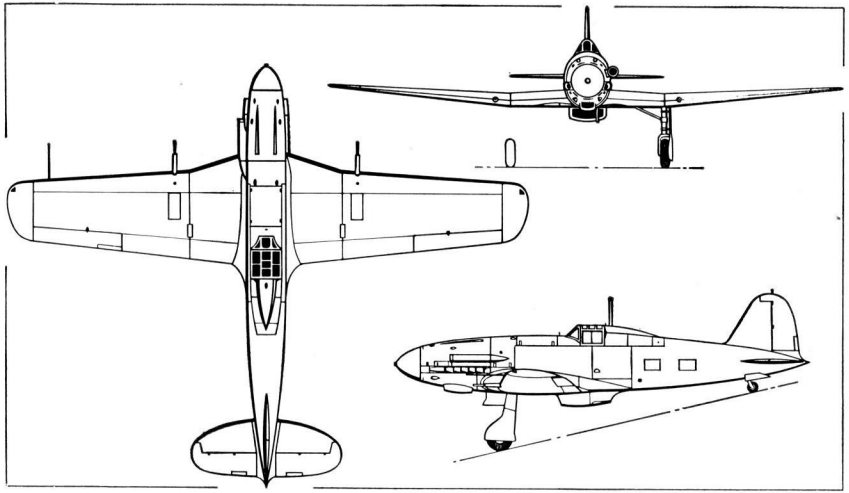
FIAT G.55 CENTAURO

ITALY

The G.55 Centauro (Centaur) was an extensively redesigned development of the G.50 Freccia and, without doubt, the best single-seat fighter produced by the Italian aircraft industry during World War II. Apart from the use of the DB 605A-1 engine, the Centauro differed from the Freccia in having a fuselage of improved fineness ratio and a redesigned wing of exceptional efficiency. This wing was a two-spar structure built in two sections bolted together on the fuselage centre line. Metal stressed-skin was employed and the metal-framed statically and aerodynamically-balanced ailerons were fabric covered.

The prototype Centauro was flown for the first time on April 30, 1942, and production was initiated early in 1943, the initial production model being the G.55/O with an armament of one 20-mm. Mauser MG 151 cannon and four 12.7-mm. Breda-SAFAT machine guns. The G.55/O was succeeded on the production line at an early stage by the G.55/I which differed in having an armament of three MG 151 cannon and two Breda-SAFAT machine guns. Deliveries of the Centauro to the 53° Stormo and the 353° Squadriglia of the 20° Gruppo had only just commenced when, on September 8, 1943, Italy capitulated, and in consequence this fighter did not see operational service with the Regia Aeronautica. However, production of the Centauro was centred in the area of Italy occupied by German forces, and with the formation of the Repubblica Sociale Italiana and the Aviazione della RSI, the fighter was selected as standard equipment for the new air arm, several thousand being ordered. An autonomous fighter squadron based at Turin was equipped with the Centauro, as were also most of the elements of the I° and II° Gruppi Caccia, but production deliveries were limited by shortages of DB 605A-1 engines and the Italian-built version of this power plant, the Fiat R.A.1050 R.C.58 Tifone, and only 105 G 55 fighters had been





completed by the time the Allies overran the remainder of Italy.

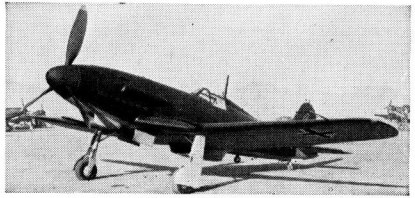
Among developments of the Centauro undertaken were the G.55/II with five 20-mm. MG 151 cannon, and the G.55S torpedo-fighter, both of which were flown in 1944. The G.55S carried a single 2,176-lb. Whitehead Fiume torpedo beneath the fuselage, the ventral radiator bath being replaced by underwing radiators and a two-position tailwheel being provided. Production of the Centauro for export was resumed after the war, a further eighty-five single-seat G.55As and two-seat G.55Bs being built.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,475 *h.p. Fiat R.A.*1050 *R.C.*58 *Tifone* (*DB* 605*A*-1) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Mauser MG* 151 *cannon with* 250 *rounds, two* 20-*mm. Mauser MG* 151 *cannon with* 200 *r.p.g., and two* 12.7-*mm. Breda-SAFAT machine guns with* 300 *r.p.g.* **Performance:** *Maximum speed,* 385 *m.p.h. at* 22,965 *ft.; cruising speed,* 348 *m.p.h.; normal range,* 746 *mls.; maximum range* (*with auxiliary fuel tanks*), 1,025 *mls.; climb to* 19,685 *ft.,* 7 *min.* 12 *sec., to* 26,250 *ft.,* 10 *min.* 11 *sec.; service ceiling,* 42,650 *ft.* **Weights:** *Empty,* 5,952 *lb.; loaded,* 8,179 *lb.* **Dimensions:** *Span,* 38 *ft.* 10½ *in.; length,* 30 *ft.* 8⅞ *in.; height,* 10 *ft.* 3¼ *in.; wing area,* 227.226 *sq. ft.*

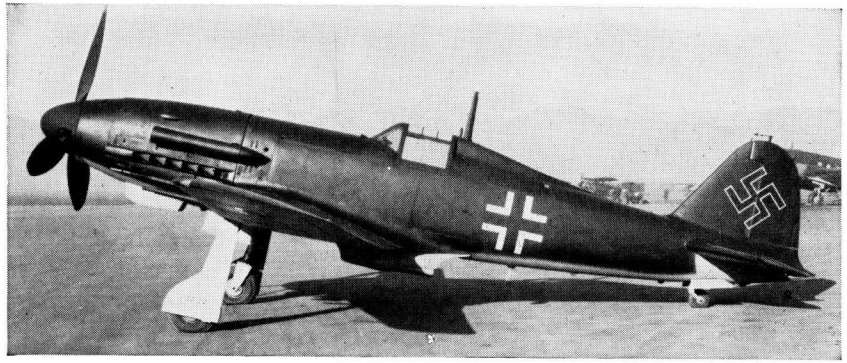
The success of the G.55 Centauro fighter powered by the Daimler-Benz DB 605A-1 engine prompted Ing. Giuseppe Gabrielli to take advantage of the increased power offered by the DB 603A—an enlarged version of the DB 605 with certain improvements and offering 1,750 h.p. for take-off and 1,510 h.p. at 18,700 ft.—to achieve an even higher performance with the basic Centauro design. A DB 603A was, therefore, installed in a production G.55/I airframe to form the prototype G.56 which was flown for the first time on March 28, 1944.

Although no major changes were made to the basic structure of the Centauro apart from some strengthening of the engine mounts, the installation of the larger DB 603A engine increased the overall length by some four-and-a-half inches, and the additional 340 lb. weight of the new power plant forward of the c.g. necessitated some rearrangement of the fighter's equipment to compensate for this.

The G.56 was tested by both Italian and German pilots, and in mock dog-fights with the Messerschmitt Bf 109G and the Focke-Wulf Fw 190A, it proved itself superior on every count, although manoeuvrability

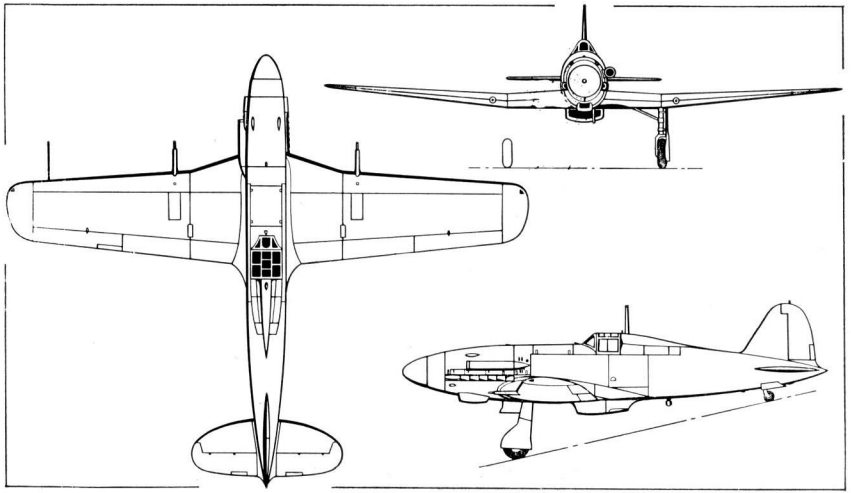


Only one prototype of the G.56 fighter was completed, this flying in March 1944.



was slightly inferior to that of the G.55. During these trials a maximum speed of 426 m.p.h. was attained at an altitude of 22,965 ft., and an altitude of 19,685 ft. was reached in 5 min. 45 sec. However, by this stage of the war, the German aero engine industry was finding some difficulty in fulfilling Luftwaffe requirements for the DB 603 engine, and there was little likelihood of any substantial deliveries being made to Italy. In consequence no preparations for the quantity production of the G.56 fighter were initiated, and before prototype trials had been completed, northern Italy had been overrun by the Allies.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,750 *h.p. Daimler-Benz DB* 603*A twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Mauser MG* 151 *cannon with* 250 *rounds, two* 20-*mm. MG* 151 *cannon with* 200 *r.p.g., and two* 12.7-*mm. Breda-SAFAT machine guns with* 300 *r.p.g.* **Performance:** *Maximum speed,* 426 *m.p.h. at* 22,965 *ft.; cruising speed,* 334 *m.p.h.; range,* 795 *mls.; time to* 19,685 *ft.,* 5 *min.* 45 *sec.; service ceiling,* 43,965 *ft.* **Weights:** *Empty,* 6,393 *lb.; loaded,* 8,497 *lb.* **Dimensions:** *Span,* 38 *ft.* 10½ *in.; length,* 31 *ft.* 1¼ *in.; height,* 10 *ft.* 6 *in.; wing area,* 227.226 *sq. ft.*



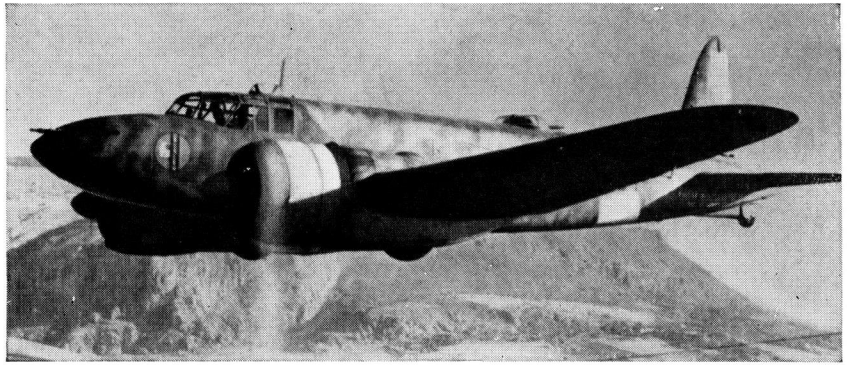
FIAT C.R.25BIS

ITALY

The C.R.25 was evolved by Ing. Celestino Rosatelli to compete in a design contest promoted by the Italian Air Ministry in 1938 for a multi-purpose aircraft for use in Italy's North African territories. The specification, which placed the accent upon range and a performance higher than offered by existing light colonial monoplanes, demanded a twin-engined aircraft suitable for the roles of long-range escort fighter, fighter-bomber and reconnaissance. To meet these requirements, Ing. Rosatelli produced a clean aircraft which, bearing a marked family resemblance to the B.R.20 bomber, employed a two-spar, three-section wing mounted in low-mid position and a rectangular section welded steel-tube fuselage. Three crew members were carried, and an internal bay provided accommodation for a maximum bomb load of 1,550 lb. or auxiliary fuel tanks.

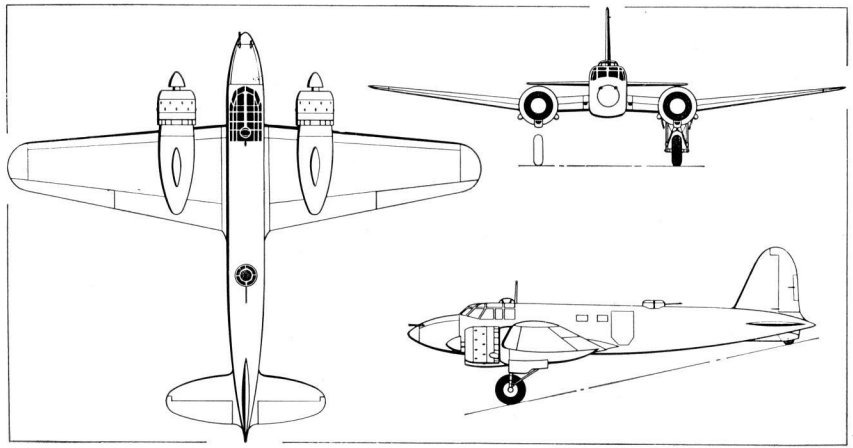
Two prototypes of the C.R.25 were flown in 1939, in which year work commenced on a pre-production batch of ten machines. One of these, designated C.R.25D, was employed as a personal transport by the Italian air attaché in Berlin, and the remaining nine aircraft were completed under the designation

(Below) One of the pre-production C.R.25 escort fighters and (above, right) one of the two prototypes.



C.R.25bis. These were issued to the 173a Squadriglia in 1941, and were intended to operate in the strategic reconnaissance role from a base in Sicily. The C.R.25bis was, in fact, employed as an escort fighter protecting convoys operating between Sicily and Italy, and was engaged by Beaufighters on at least one occasion. The armament of the C.R.25bis, which comprised two fixed forward-firing 12.7-mm. Breda-SAFAT machine guns and a similar gun in a hydraulically-operated dorsal turret, proved inadequate, with the result that the type was withdrawn from operations and relegated to the role of light transport. In 1940, work had been initiated on a more heavily armed variant, the C.R.25quater, but the prototype of this version was not completed and further development of the basic design was abandoned.

Type: *Three-seat Long-range Reconnaissance-Fighter and Fighter-bomber.* **Power Plants:** *Two* 840 *h.p. Fiat A* 74 *R.C.*38 *fourteen-cylinder radial air-cooled engines.* **Armament:** *Two forward-firing* 12.7-*mm. Breda-SAFAT machine guns and one* 12.7-*mm. gun in dorsal turret, plus* 1,550 *lb. of bombs.* **Performance:** *Maximum speed,* 273 *m.p.h. at* 13,120 *ft.,* 285 *m.p.h. at* 18,200 *ft.; cruising speed,* 245 *m.p.h.; normal range,* 972 *mls.; maximum range,* 1,305 *mls.; service ceiling,* 26,575 *ft.* **Weights:** *Empty,* 9,645 *lb.; loaded,* 14,385 *lb.* **Dimensions:** *Span,* 51 *ft.* 10 *in.; length,* 44 *ft.* 5¾ *in.; height,* 11 *ft.* 1¾ *in.; wing area,* 421.945 *sq. ft.*



I.M.A.M. Ro.57 ITALY

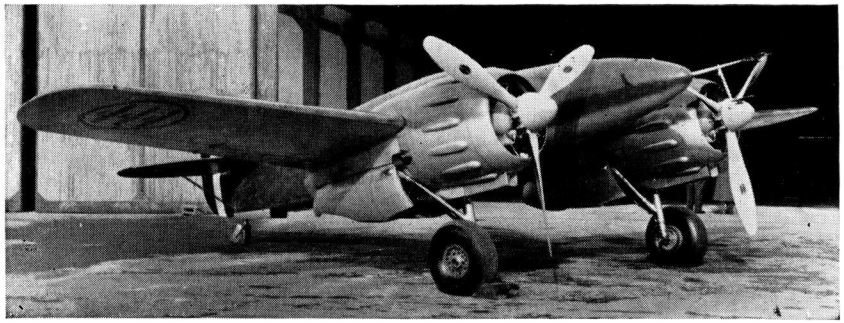
First projected in 1939 by the S.A. Industrie Meccaniche e Aeronautiche Meridionali, the Ro.57 twin-engined single-seat interceptor fighter was designed by Ing. Giovanni Galasso assisted by engineers Callerio and Fiore, production deliveries commencing in 1942 to the Regia Aeronautica. The Ro.57 was of mixed construction, a wooden wing being married to a steel-tube, duralumin-covered fuselage, but, although of relatively advanced conception, the fighter was under-powered; it retained the classic Italian single-seat fighter armament of two 12.7-mm. Breda-SAFAT machine guns, and lacked the manoeuvrability of its single-engined contemporaries.

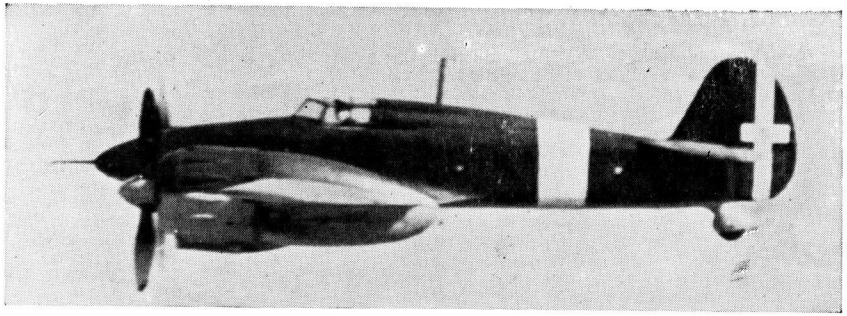
Initially, the Ro.57 was delivered in small numbers to the home-based interceptor squadrons of the Regia Aeronautica, but its inadequate performance resulted in its adaptation for the fighter-bomber and dive-bomber roles. The modified version was designated Ro.57bis and differed from the interceptor version in having dive brakes, a crutch under the fuselage for bombs of up to 1,100 lb., and a heavier forward-firing armament, the twin 12.7-mm. guns being augmented by a pair of 20-mm. cannon. The Ro.57bis was introduced on operations early in 1943 and proved more successful than the original interceptor, but relatively few aircraft of this type were delivered to the Regia Aeronautica.

The following specification relates to he original interceptor model.

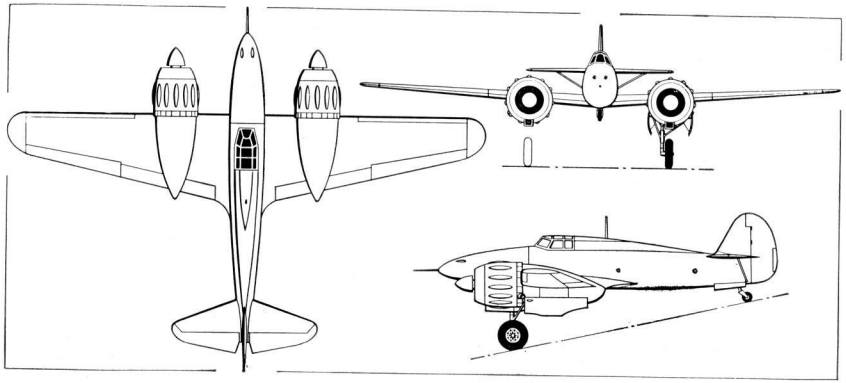
Type: *Single-seat Interceptor Fighter.* **Power Plants:** *Two* 840 *h.p. Fiat A.*74 *R.C.*38 *fourteen-cylinder air-cooled radial engines.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns in the fuselage nose.* **Performance:** *Maximum speed,* 311 *m.p.h. at* 16,400 *ft.; cruising speed,*

The Ro.57 was used in small numbers by home-based interceptor squadrons of the Regia Aeronautica.





242 *m.p.h.*; *normal range*, 745 *mls.*; *climb to* 19,685 *ft.*, 9 *min.* 30 *sec.*; *service ceiling*, 25,590 *ft.* **Weights:** *Empty*, 7,694 *lb.*; *loaded*, 11,000 *lb.* **Dimensions:** *Span*, 41 *ft.* 0 *in.*; *length*, 28 *ft.* 10½ *in.*; *height*, 9 *ft.* 6⅛ *in.*; *wing area*, 247.57 *sq. ft.*

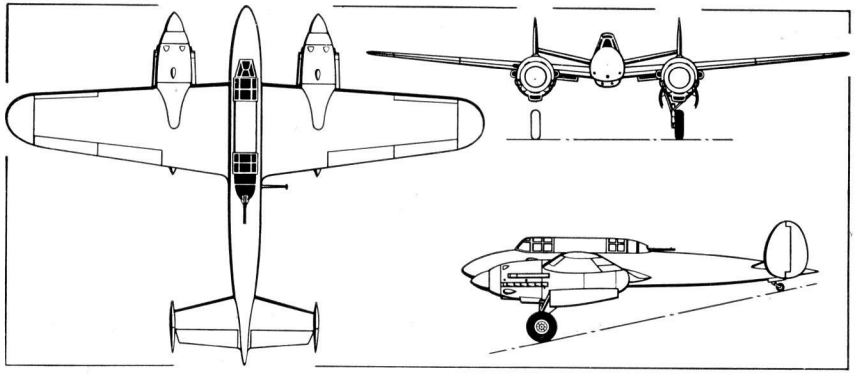


I.M.A.M. Ro.58 ITALY

Although the Italian aircraft industry failed to bring to operational status a successful twin-engined fighter, the Regia Aeronautica was impressed by the strategic fighter concept. It was slow in making its requirements known, however, and several promising Italian warplanes in this category appeared too late to see combat. One such aircraft was the Ro.58 produced by the S.A. Industrie Meccaniche e Aeronautiche Meridionali of Naples, this company having previously developed the unsuccessful Ro.57.

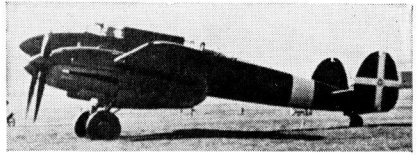
The Ro.58 was not of particularly advanced conception, its design having obviously been influenced markedly by that of the Messerschmitt Bf 110. Of all-metal construction, the Ro.58 was intended for use as a long-range escort fighter, a day and night bomber destroyer, and as a close-support fighter. For the fighting role the forward-firing armament comprised five 20-mm. Mauser MG 151 cannon, two of these being housed in a ventral tray. For the close-support role this tray was to have been removed to provide space for a bomb rack. The role of torpedo fighter was also considered for this machine.

The sole prototype of the Ro.58 was completed early in 1943 and flown to the Guidonia test establishment for official trials. At Guidonia it proved to possess exceptional handling



characteristics for an aircraft of its size, and plans were prepared for the quantity production of the Ro.58, later models being powered by the Fiat R.A.1050 R.C.58 Tifone, the licence-built version of the DB 605A-1. However, the Italian Armistice frustrated these plans and further development of the Ro.58 was abandoned.

Type: *Two-seat Long-range Escort, Close-support and Day and Night Fighter.* **Power Plants:** *Two* 1,175 *h.p. Daimler-Benz DB* 601*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Five* 20-*mm. Mauser MG* 151 *cannon and one (rear-firing)* 12.7-*mm. Breda-SAFAT machine gun.* **Performance:** *Maximum speed,* 376 *m.p.h. at* 17,060 *ft.; cruising speed,* 314 *m.p.h.; climb to* 19,685 *ft.,* 9 *min.; service ceiling,* 31,170 *ft.; range,* 932 *mls. at econ. cruising.* **Weights:** *Empty,* 9,590 *lb.; loaded,* 13,448 *lb.* **Dimensions:** *Span,* 43 *ft.* 11½ *in.; length,* 32 *ft.* 5¾ *in.; height,* 11 *ft.* 1⅞ *in.; wing area,* 282.014 *sq. ft.*

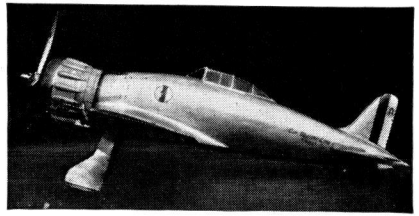


MACCHI C.200 SAETTA

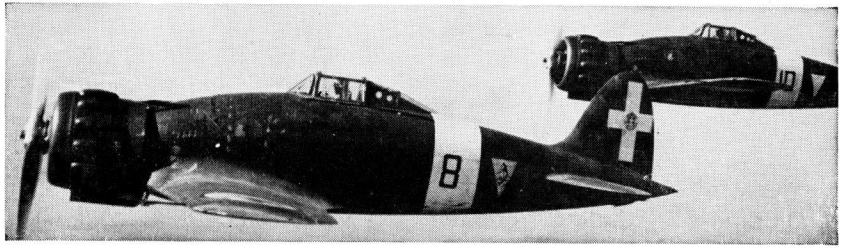
ITALY

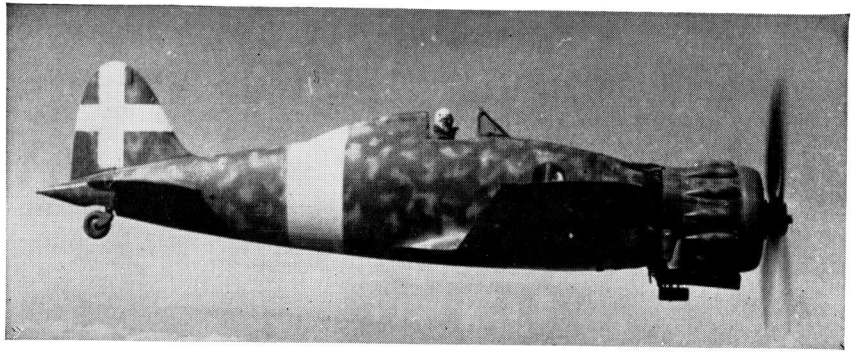
After the termination of Italy's campaign in Ethiopia, the Regia Aeronautica prepared "Programme R" which called for the delivery of 3,000 new aircraft and included the re-equipment of the Stormi Caccia Terrestre with new fighter monoplanes for which a specification was prepared. Initially, this specification demanded a bomber interceptor carrying a single 12.7-mm. gun and possessing an endurance of one hour, but both armament and endurance were doubled at an early stage. To meet the requirements of the specification, Mario Castoldi, chief designer of Aeronautica Macchi and designer of some of the last Schneider Trophy racing sea-planes and the M.C.72 which twice gained the world air speed record for Italy, produced the M.C.200, the prototype of which (MM 336) flew for the first time on December 24, 1937.

The M.C.200, which, during early trials at Guidonia, reached a speed of 500 m.p.h. in a dive, was the winner of the interceptor contest held in 1938, and production was initiated on a first series of ninety-nine machines (MM 4495-4593). Armament of the M.C.200, later dubbed Saetta (Arrow), was relatively light by world standards, comprising two 12.7-mm. guns, and the first thirteen machines carried 310 rounds per gun, although subsequent Serie Ima aircraft carried 370 rounds per gun. The first twenty-five aircraft were fitted with Fiat-Hamilton constant-speed airscrews but later machines had a Piaggio P.1001 airscrew, also of constant-speed type. It was originally proposed to assign the first production M.C.200 fighters to the 4º Stormo (the Francesco

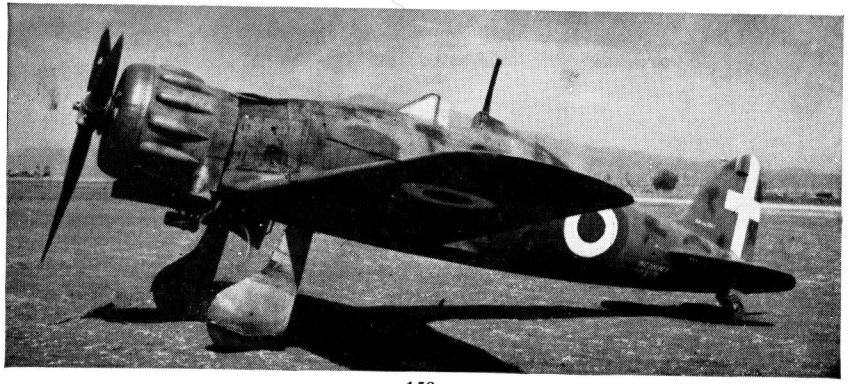


(Above, right) The first Saetta prototype (MM 336*) and (below) M.C.*200*s of the first production series.*



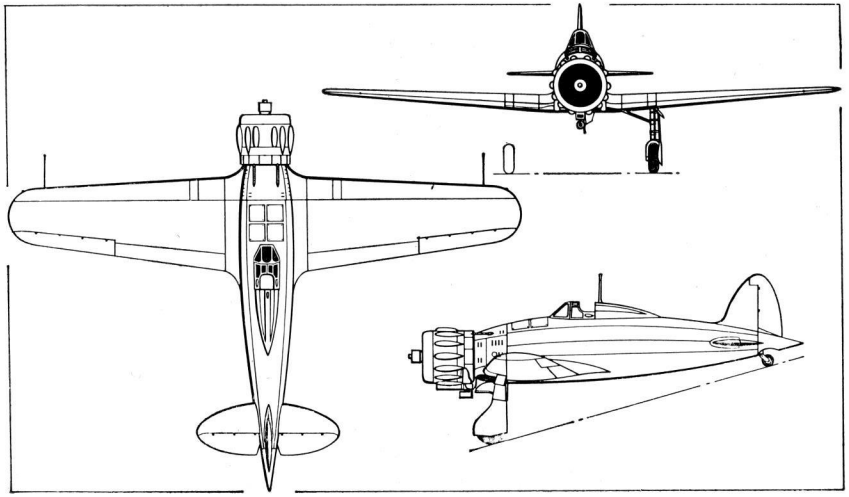


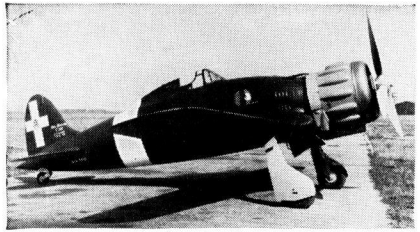
(*Above*) *M.C.*200 *Saetta of the* 22° *Gruppo which operated over Russia with the Corpo di Spedizione Italiano until the spring of* 1942, *and* (*below*) *a M.C.*200 *of the Italian Co-belligerent Air Force.*



Baracca Stormo), but its pilots were reluctant to exchange the extreme manoeuvrability of their biplanes for the higher performance of the monoplane, and the new machines were, therefore, issued to the Ima Stormo which, by November 1, 1939, had received twenty-nine M.C.200s, a further 572 fighters of this type being on order at this time. The enclosed cockpit was disliked by service pilots, and after completion of the first production series, an open cockpit was adopted.

When, on June 10, 1940, Italy entered the war, the Regia Aeronautica had received 156 M.C.200 Saetta fighters, and the 152° and 153° Gruppi of the 54° Stormo Caccia Terrestre, based at Airasca (Torino) and Vergiate (Varese) respectively, and the 6° Gruppo Autonomo based at Catania, had re-equipped with this aircraft, although these did not participate in the brief fighting with the French as the Saetta had been temporarily grounded as the result of two fatal crashes. There had been some delay in ascertaining the cause of these accidents, and at one time it seemed likely that manufacture of the fighter would have to be halted. However, it was discovered that the accidents had resulted from high-speed stalls which necessitated modifications to the aerofoil. After the necessary modifications had been made, the Saetta proved itself an exceptional aeroplane in several respects. It possessed outstanding manoeuvrability, was ex-





A late production M.C.200 with modified cockpit.

tremely stable and was in every respect a pilot's aeroplane with finger-light handling qualities under all conditions. Although the Saetta was slower than the majority of the fighters by which it was later to be opposed, it could turn inside all of them, including the Spitfire which was the only Allied fighter that could outclimb the M.C.200.

The Saetta fought over Greece, Yugoslavia and Malta during 1940, and was generally considered much superior to the contemporary Fiat G.50. It was later used extensively as an escort for S.M.79 and Ju 87 bombers over the Mediterranean and in North Africa and in 1941, the Saetta-equipped 22° Gruppo with fifty-one fighters was transferred to Russia to operate with the Corpo di Spedizione Italiano in Russia, operating there until the spring of 1942 when it was replaced by the similarly-equipped 21° Gruppo.

Although the Saetta's performance was limited by its bulky, drag-producing, air-cooled radial engine, it possessed an extremely sound structure and proved amenable for adaptation as a low-altitude fighter-bomber, a role in which it was increasingly employed as the superior M.C.202 Folgore became available. The prototype M.C.200 weighed 3,902 lb. empty and 4,850 lb. loaded, but successive production series featured additional armour protection and equipment which progressively increased the basic weight. For instance, the empty weight of the M.C.200 Serie XX was increased to 4,321 lb., and that of the Serie XXI to 4,451 lb., the latter having a loaded weight of 5,597 lb. In the fighter-bomber role the Saetta could carry eight 33-lb. bombs or two 110-lb., 220-lb. or 353-lb. bombs. Alternatively, two 22 or 33 Imp. gal. drop tanks could be carried. Late production Saetta fighters employed an identical wing to that of the M.C.202, some having the additional pair of 7.7-mm. wing-mounted machine guns.

Approximately one thousand M.C.200 fighters were manufactured, of which 395 were built by the parent company, the remainder being built by Breda and S.A.I.-Ambrosini, and after the Italian Armistice, twenty-three Saettas succeeded in reaching Allied airfields in southern Italy, beginning operations with the Italian Co-belligerent Air Force shortly afterwards.

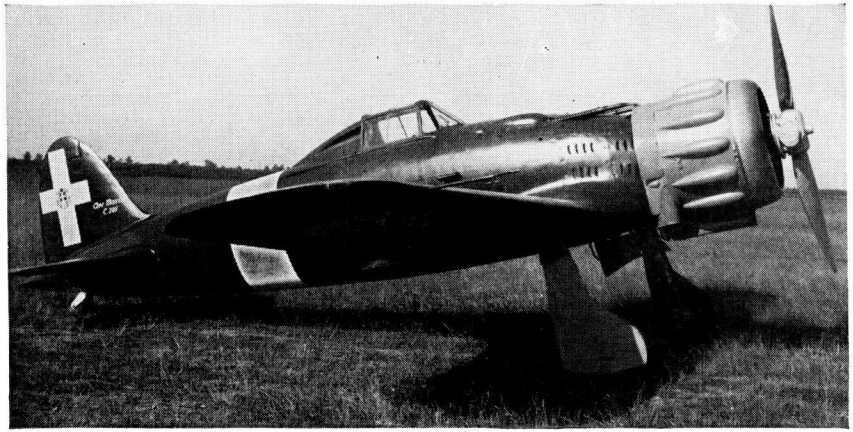
Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 870 *h.p. Fiat A.*74 *R.C.*38 *fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 370 *r.p.g.* **Performance:** *Maximum speed,* 312 *m.p.h. at* 14,750 *ft.; normal range,* 354 *mls. at* 283 *m.p.h.,* (*with* 66 *Imp. gal. fuel externally*), 540 *mls. at* 279 *m.p.h.; time to* 3,280 *ft.,* 1 *min.* 3 *sec., to* 9,840 *ft.,* 3 *min.* 24 *sec., to* 16,400 *ft.,* 5 *min.* 52 *sec.; service ceiling,* 29,200 *ft.* **Weights:** *Empty,* 4,175 *lb.; normal loaded,* 5,121 *lb.; maximum,* 5,715 *lb.* **Dimensions:** *Span,* 34 *ft.* 8½ *in.; length,* 26 *ft.* 10⅜ *in.; height,* 11 *ft.* 6 *in.; wing area,* 180.83 *sq. ft.*

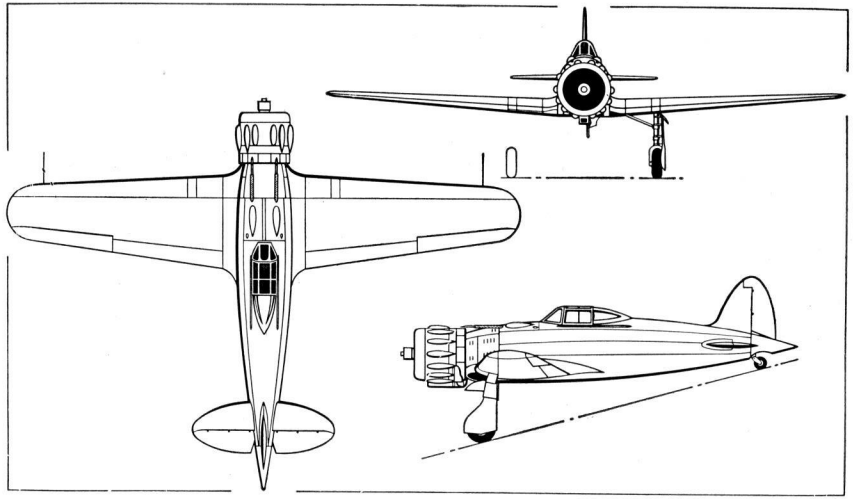
MACCHI C.201 ITALY

Towards the end of 1938, the Italian Ministero dell' Aeronautica organised a contest for a more advanced single-seat interceptor fighter monoplane than the M.C.200 Saetta which had just entered production for the Regia Aeronautica. Mario Castoldi endeavoured to meet the new requirements with a more advanced version of the Saetta, the M.C.201, which retained the wings, undercarriage and tail assembly of the earlier fighter, these being married to a slimmer fuselage which discarded the pronounced "hump back" characterising the Saetta. It was proposed to install the Fiat A.76 R.C.40 air-cooled radial engine which, then bench running, was rated at 1,000 h.p.

During the construction of the prototype M.C.201 (MM 436) the decision to abandon further development of the Fiat A.76 was taken, and in consequence, when flight trials commenced in August 1940, an 870 h.p. Fiat A.74 R.C.38 radial similar to that employed by the Saetta was installed. However, prior to the completion of the M.C.201, the Aeronautica Macchi concern had privately purchased a Daimler-Benz DB 601 liquid-cooled inline engine from Germany, and installed this in a parallel development of the basic Saetta

The sole prototype M.C.201 was flown with an A.74 R.C. 38 in place of the A.76 for which it was designed.





design, the M.C.202, which was subsequently to enter production for the Regia Aeronautica as the Folgore. The prototype M.C.202 was flown for the first time on August 10, 1940, and it was immediately obvious that this fighter offered numerous advantages over the M.C.201. Thus development of the latter was abandoned.

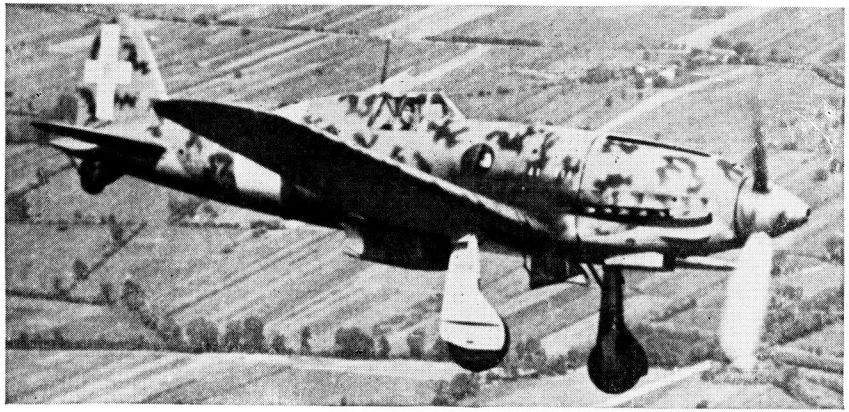
Apart from the lowering of the upper decking of the fuselage which resulted in the semi-external mounting of the twin Breda-SAFAT machine guns, and the provision of a redesigned cockpit canopy, the M.C.201 prototype differed little from the Saetta, and overall performance was generally similar. The following specification relates to the proposed production model of the M.C.201 with the Fiat A.76 engine.

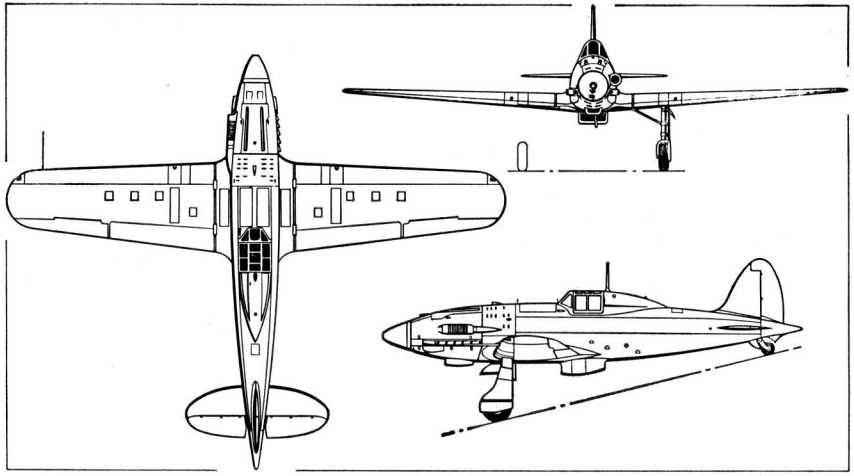
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,000 *h.p. Fiat A.*76 *R.C.*40 *fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 370 *r.p.g.* **Performance:** *Maximum speed,* 342 *m.p.h.; cruising speed,* 286 *m.p.h.; range,* 373 *mls.; normal endurance,* 1 *hr.* 20 *min.; service ceiling,* 29,530 *ft.* **Weights:** *Empty,* 4,297 *lb.; loaded,* 5,258 *lb.* **Dimensions:** *Span,* 34 *ft.* 8½ *in.; length,* 26 *ft.* 10⅜ *in.; height,* 11 *ft.* 6 *in.; wing area,* 180.83 *sq. ft.*

MACCHI C.202 FOLGORE

The M.C.202 Folgore (Lightning), which was first employed by the 9º Gruppo of the Regia Aeronautica's 4º Stormo Caccia Terrestre over Sicily in the late summer of 1941, raised Italian fighter design to world standards, being the Regia Aeronautica's first wartime operational interceptor to compare favourably with the firstline fighters of the other major combatants. Retaining the beautiful control co-ordination and superlative manoeuvrability which had characterised its production predecessor, the M.C.200 Saetta, the M.C.202 Folgore was manufactured in several series by the Macchi factories at Varese-Schiranna and Lonate Pozzolo, and by the Breda and S.A.I.-Ambrosini plants at Sesto S. Giovanni and Passignano, approximately 1,500 fighters of this type being produced during 1941–43.

The prototype M.C.202 (MM 445) powered by an imported Daimler-Benz DB 601A-1 engine flew for the first time on August 10, 1940, and so successful were initial trials that quantity production was commenced immediately by Breda under sub-contract, and by making use of a considerable proportion of the jigs and tooling for the earlier Saetta, the first production deliveries began only some eight months later. The Folgore's structure was essentially similar to that of the Saetta, the vertical and horizontal tail surfaces and undercarriage being identical as were also the wings, apart from the installation of 8.8 Imp. gal. fuel tanks in each of the inboard wing sections to supplement the 59 Imp. gal. and 17.6 Imp.

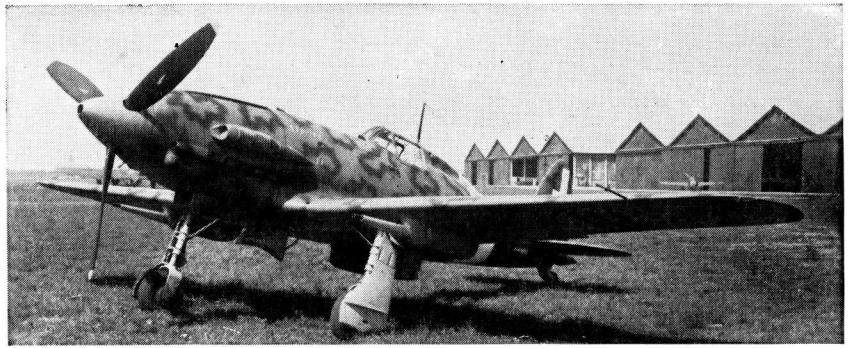




gal. fuselage tanks. The fuselage was of improved aerodynamic form. An enclosed cockpit was employed, the Italian fighter pilot's dislike of this development having at last been overcome, and the strengthened canopy frame rendered unnecessary the anti-turnover structure aft of the pilot's head featured by the Saetta.

Initial production Folgore fighters were powered by imported DB 601A-1 engines, but the majority of the fighters of this type manufactured received a licence-built version of this engine, the Alfa Romeo R.A.1000 R.C.41-I Monsonie, driving a Piaggio P.1001 constant-speed airscrew. Early production series fighters had the light built-in armament of two 12.7-mm. machine guns mounted over the engine with 400 r.p.g., but later production series (e.g., Serie IX-XI) also carried a 7.7-mm. machine gun between the seventh and eighth rib of each wing with 500 r.p.g., while one batch carried a 20-mm. Mauser MG 151 cannon (with 200 r.p.g.) under each wing. Late production models featured bullet-proof windscreens and underwing shackles for two 22 or 33 Imp. gal. drop tanks or 110-lb., 220-lb. or 330-lb. bombs.

The first M.C.202 Folgore fighters reached Libya on November 25, 1941, these belonging to the 1° Stormo Caccia Terrestre. The similarly-equipped 4° Stormo arrived in the Western Desert in the following May, and the



One production batch of M.C.202 Folgore fighters carried underwing Mauser MG 151 cannon.

Folgore rapidly established an ascendancy over the opposing Hawker Hurricane and Curtiss P-40 fighters. Early in September 1942, the first Folgores were delivered to the 21° Gruppo fighting over Russia where they served until May of the following year.

The Folgore was the most successful Italian fighter to see extensive wartime service, but inadequate production of the DB 601A-1 engine by Italian factories (which had to be shared with the Re.2001 and rarely exceeded fifty units per month) and strict limitations on the deliveries of surplus engines from Germany necessitated the retention of the obsolete M.C.200 Saetta in parallel production, shortage of power plants preventing a complete change-over of the production lines to the superior fighter. The parent company completed 392 Folgores.

The following specification relates to the late production Serie IX-XI Folgore fighter.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,175 *h.p. Alfa Romeo R.A.*1000 *R.C.*41-I *Monsoni (DB* 601*A*-1) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 400 *r.p.g. and two* 7.7-*mm. Breda-SAFAT guns with* 500 *r.p.g., plus two* 110-*lb.*, 220-*lb. or* 353-*lb. bombs.* **Performance:** *Maximum speed,* 309 *m.p.h. at sea level,* 338 *m.p.h. at* 6,560 *ft.*, 364 *m.p.h. at* 13,120 *ft.*, 370 *m.p.h. at* 16,400 *ft.*; *time to* 3,280 *ft.*, 39 *sec., to* 6,560 *ft.*, 1 *min.* 28 *sec., to* 13,120 *ft.*, 3 *min.* 32 *sec., to* 19,685 *ft.*, 5 *min.* 55 *sec.*; *service ceiling,* 37,730 *ft.*; *normal range,* 475 *mls.* **Weights:** *Empty,* 5,181 *lb.*; *normal loaded,* 6,459 *lb.*; *maximum,* 6,636 *lb.* **Dimensions:** *Span,* 34 *ft.* 8½ *in.*; *length,* 29 *ft.* 0⅛ *in.*; *height,* 9 *ft.* 11½ *in.*; *wing area,* 180.83 *sq. ft.*

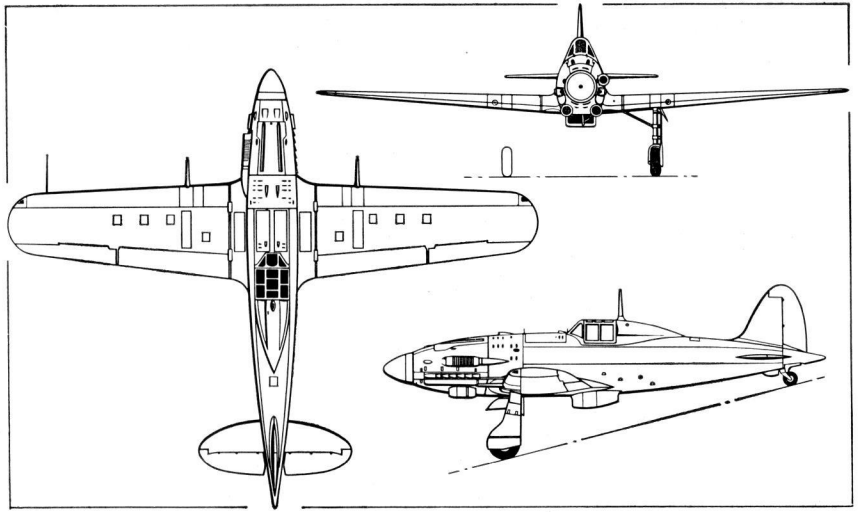
MACCHI C.205V VELTRO

ITALY

A progressive development of the M.C.202 Folgore, the M.C.205V Veltro (Greyhound) fighter-bomber differed from its predecessor primarily in having a Daimler-Benz DB 605 engine rated at 1,475 h.p. for take-off. In fact, the first prototype Veltro, which flew for the first time on April 19, 1942, employed a Folgore airframe. The initial production series of the Veltro retained the armament of the ultimate production model of the Folgore which comprised two 12.7-mm. and two 7.7-mm. machine guns, but the Serie III aircraft relinquished the wing-mounted 7.7-mm. guns in favour of a pair of 20-mm. Mauser MG 151 cannon with 250 r.p.g.

The first recorded operational sortie of M.C.205V Veltro fighters took place on the eve of the Allied landings in Sicily, on July 8, 1943, when fifteen aircraft of this type escorted torpedo bombers attacking Allied naval forces shelling the Pantelleria defences. When, on September 8, 1943, Italy capitulated, the Regia Aeronautica had only sixty-six Veltro fighters on strength of which thirty-five were serviceable. These were distributed among the 3º Stormo at Cerveteri, the 4º Stormo at Castrovillari, the 51º Stormo at Monserrato, and the 310º Squadriglia Aerofotografica at Guidonia. Only six Veltro fighters reached Allied lines after Marshal Badoglio's call to surrender, the remaining machines being absorbed by Aviazione della RSI which continued to fight alongside the Luftwaffe, equipping components of the Iº and IIº Gruppo Caccia. Limited production of the Veltro continued after the Armistice, total production reaching 262 aircraft.

The Veltro's structure was similar to that



of the earlier Saetta and Folgore fighters, featuring an oval section all-metal monocoque fuselage and a two-spar all-metal wing with smooth stressed skin and fabric-covered control surfaces. It bore comparison with the best fighters by which it was opposed and, pilot for pilot, was one of the few Axis fighters capable of matching the redoubtable P-51D Mustang.

The following specification relates to the M.C.205V Serie III.

Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,475 *h.p. Fiat R.A.*1050 *R.C.*58 *Tifone* (*DB* 605*A*-1) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 400 *r.p.g. and two* 20-*mm. Mauser MG* 151 *cannon with* 250 *r.p.g., plus two* 110-*lb.*, 220-*lb. or* 353-*lb. bombs.* **Performance:** *Maximum speed,* 399 *m.p.h. at* 23,620 *ft.*; *maximum cruising speed,* 310 *m.p.h.*; *range,* 646 *mls.*; *time to* 3,280 *ft.*, 53 *sec., to* 9,840 *ft.*, 2 *min.* 40 *sec., to* 16,400 *ft.*, 4 *min.* 47 *sec., to* 22,965 *ft.*, 7 *min.* 6 *sec.*; *service ceiling,* 36,090 *ft.* **Weights:** *Empty,* 5,691 *lb.*; *loaded,* 7,514 *lb.* **Dimensions:** *Span,* 34 *ft.* 8½ *in.*; *length,* 29 *ft.* 0½ *in.*; *height,* 9 *ft.* 11½ *in.*; *wing area,* 180.83 *sq. ft.*

MACCHI C.205N ORIONE

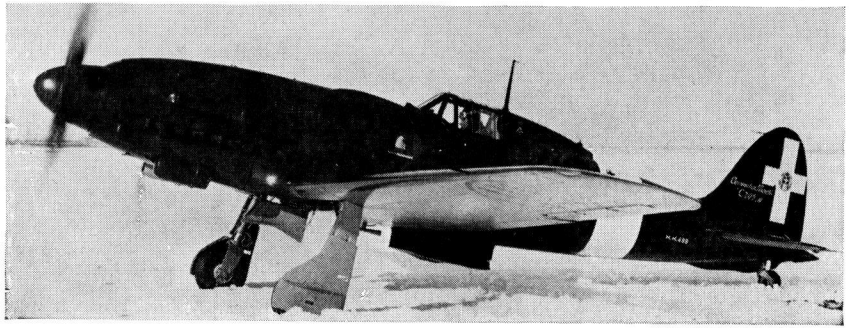
ITALY

Whereas the M.C.205V Veltro was essentially the earlier M.C.202 Folgore fighter apart from the installation of the more powerful Daimler-Benz DB 605 engine, the M.C.205N Orione (Orion) represented a more advanced development of the basic design, embodying considerable refinement. Two prototypes were built, the M.C.205N-1 (MM 499) and the M.C.205N-2 (MM 500), these differing principally in the type and arrangement of their armament. The M.C.205N-1, which flew for the first time on November 1, 1942, carried four 12.7-mm. machine guns and one 20-mm. cannon grouped in the fuselage nose, two of the machine guns being housed in fairings over the wing roots. The M.C.205N-2, which first flew on May 19, 1943, discarded the wing-root mounted machine guns in favour of wing-mounted 20-mm. cannon, total armament thus being three 20-mm. cannon and two 12.7-mm. machine guns.

While the Veltro was a straightforward adaptation of the Folgore for the DB 605 engine, the M.C.205N Orione was redesigned to take full advantage of the increased power, the fuselage being of improved fineness ratio and new long-span wings being employed, the tail surfaces and undercarriage remaining essentially similar to those of the Veltro.

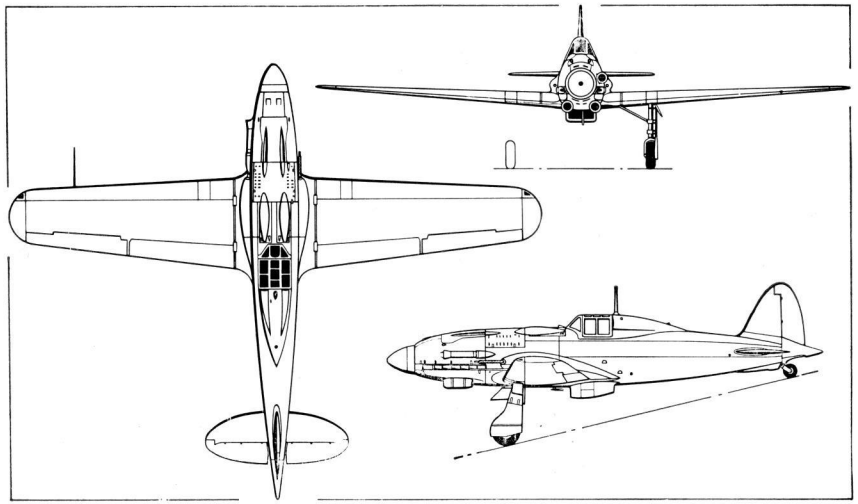
Production priority was allocated to the Veltro as this fighter employed jigs and tools used in the Folgore production programme whereas the Orione demanded much new tooling, and thus manufacture of the later fighter had not commenced at the time of Italy's capitulation. Progressive developments of the basic design were the M.C.206 and M.C.207 which were to have employed a similar engine to that of the Orione and a wing of 40 ft. 9 in. span. The former was to have carried a similar armament to that of the M.C.205N-2, and the latter was to have had four wing-mounted 20-mm. MG 151 cannon. Prototypes of both fighters were under construction at the time of the capitulation.

The M.C.205N-1 Orione was one of the best fighters developed in Italy during the war years.



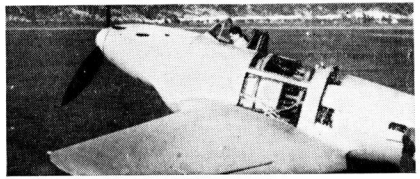
The following specification relates to the M.C. 205N-1, figures in parentheses relating to the M.C.205N-2.

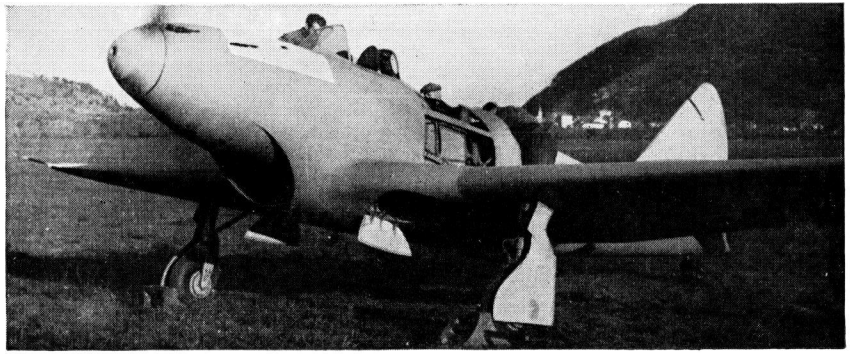
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,475 *h.p. Daimler-Benz DB* 605*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 400 *r.p.g., two* 12.7-*mm. guns with* 300 *r.p.g., and one* 20-*mm. Mauser MG* 151 *cannon with* 200 *rounds* (*two* 12.7-*mm. machine guns with* 400 *r.p.g., one* 20-*mm. MG* 151 *with* 200 *rounds and two* 20-*mm. cannon with* 250 *r.p.g.*). **Performance:** *Maximum speed,* 367 (365) *m.p.h. at* 13,120 *ft.,* 372 (371) *m.p.h at* 16,400 *ft.,* 385 (383) *m.p.h. at* 19,685 *ft.,* 390 (389) *m.p.h. at* 22,965 *ft.; climb to* 3,280 *ft.,* 41 *sec.* (1 *min.* 7 *sec.*), *to* 9,840 *ft.,* 2 *min.* 24 *sec.,* (3 *min.* 39 *sec.*), *to* 16,400 *ft.,* 4 *min.* 46 *sec.* (6 *min.* 14 *sec.*), *to* 26,250 *ft.,* 9 *min.* 48 *sec.* (10 *min.* 47 *sec.*); *service ceiling,* 36,910 (35,430) *ft.* **Weights:** *Empty,* 5,941 (6,082) *lb.; loaded,* 7,983 (8,364) *lb.* **Dimensions:** *Span,* 36 *ft.* 10⅞ *in.; length,* 31 *ft.* 4 *in.; height,* 10 *ft.* 8 *in.; wing area,* 204.514 *sq. ft.*

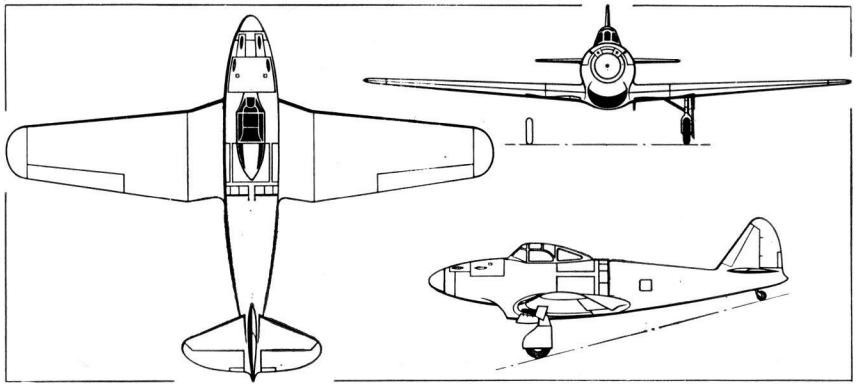


During 1938 the Piaggio company began to examine the possibilities of installing a radial air-cooled engine as a "buried" power plant, driving an airscrew by means of an extension shaft. Such an installation was expected to offer several advantages in a single-seat interceptor fighter, the most important of which were the improved manoeuvrability resulting from positioning the engine near to the aircraft's centre of gravity; the substantial reduction in drag; the improved visibility from the cockpit resulting from a finely tapered forward fuselage, and the possibility of close-grouping the forward-firing guns. In March 1939, after completing preliminary studies, Piaggio submitted their proposals to the Ministero dell' Aeronautica for a single-seat fighter, the P.119, embodying these features. A year elapsed before official interest in the project was indicated, and before the end of 1940 instructions had been received to proceed with the construction of a prototype and a second airframe for static and dynamic tests.

Many problems had to be solved before a suitable cooling effect was obtained, but an effective system was eventually evolved, the cooling air entering a large scoop beneath the forward fuselage, being conducted to the engine by trunks, and exhausting through annular openings in the fuselage level with the wing







trailing edge. An extremely clean all-metal monocoque fuselage was employed, the wing was a two-spar structure with metal flush-riveted skinning, and a wide-track undercarriage was fitted, the main wheels retracting into wells forward of the main spar. From an early stage in the P.119's development there had been official interest in the secondary role of ground attack, and provision was made for the attachment of two bomb racks outboard of the main undercarriage members with a third rack under the fuselage. It was intended to install a Piaggio P.XXII engine rated at 1,700 h.p. for take-off, but pending the availability of this engine a Piaggio P.XV was installed in the prototype which performed its first ground trials between the 12th and 16th of November 1942. The first flight test was made on December 19, 1942, and a considerable amount of flying had been completed with the prototype by August 2, 1943 when the last test was made. The P.119 was to have subsequently been flown by Regia Aeronautica pilots to determine the fighter's suitability for service use, but with the Armistice further development was abandoned.

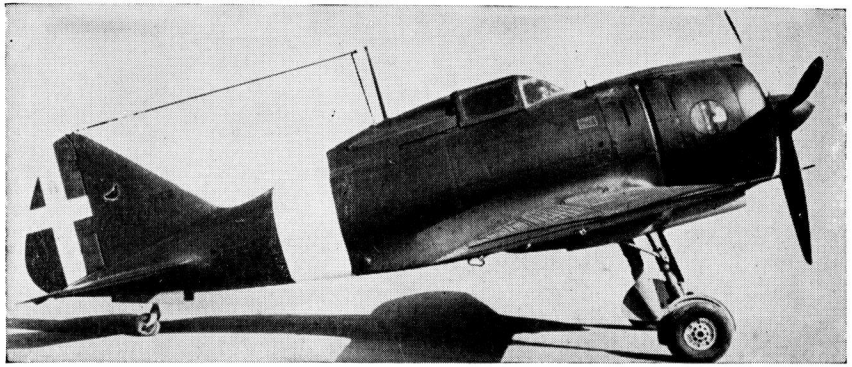
Type: *Single-seat Interceptor and Fighter-bomber.* **Power Plant:** *One* 1,700 *h.p. Piaggio P.XV R.C.*60/2*V eighteen-cylinder radial air-cooled engine.* **Armament:** *Four* 12.7-*mm. Breda-SAFAT machine guns and one* 20-*mm. Breda CL*20 *cannon in the fuselage.* **Performance:** *Maximum speed,* 358 *m.p.h. at* 10,000 *ft.,* 392 *m.p.h. at* 20,000 *ft.,* 400 *m.p.h. at* 22,300 *ft.; range,* 940 *mls. at* 340 *m.p.h. at* 20,000 *ft.; climb to* 10,000 *ft.,* 3 *min.* 15 *sec., to* 20,000 *ft.,* 7 *min.* 15 *sec., to* 30,000 *ft.,* 12 *min.* 30 *sec.; service ceiling,* 41,340 *ft.* **Weights:** *Empty,* 5,374 *lb.; loaded,* 9,020 *lb.* **Dimensions:** *Span,* 42 *ft.* 7¾ *in.; length,* 31 *ft.* 10 *in.; height,* 9 *ft.* 10 *in.; wing area,* 299.2 *sq. ft.*

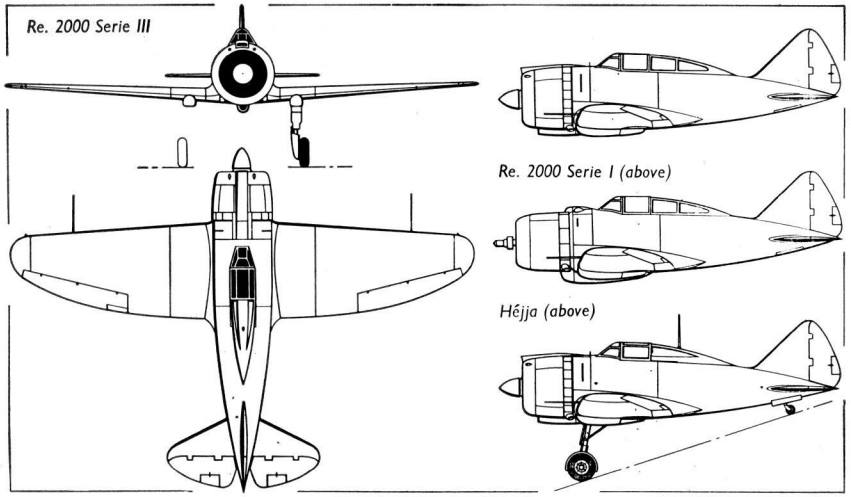
REGGIANE RE.2000 FALCO I

ITALY

The first fighter to be produced by the Officine Meccaniche "Reggiane" S.A. of Reggio Emilia, one of the many companies controlled by Count Gianni Caproni, the Re.2000 was designed in 1937 by engineers Alessio and Longhi who evidently found their inspiration in the Seversky P-35 to which the Italian fighter bore a very marked resemblance. Dubbed Falco by its manufacturers (this name being adopted officially by the Regia Aeronautica for the Fiat C.R.42), the prototype Re.2000 was flown in 1938 and demonstrated during the course of that year at Guidonia, where it was flown by Comandante de Bernardi in competition with the Macchi C.200. Powered by a Piaggio P.XI R.C.40 radial rated at 870 h.p. at sea level and 986 h.p. at 13,100 ft., the Re.2000 prototype attained a maximum speed of 320 m.p.h. at 16,400 ft.; it reached an altitude of 19,685 ft. in 6 min. 23 sec., and its range was 646 mls. at 233 m.p.h. at 19,685 ft., or 466 mls. at 273 m.p.h. at 26,250 ft. Manoeuvrability was outstanding and its handling characteristics were generally superior to those of its competitor. In fact, at a later date, in mock dogfights with the Bf 109E, the Re.2000 was the victor when flown both by Italian and German pilots. In the opinion of Air Ministry officials evaluating the Re.2000 and M.C.200, the Reggiane prototype possessed certain structural deficiencies, and the fuel tanks in the wing centre section were inadequately protected and inconveniently situated for refuelling. Thus, the M.C.200 was selected for quantity production, and the Reggiane fighter was offered for export.

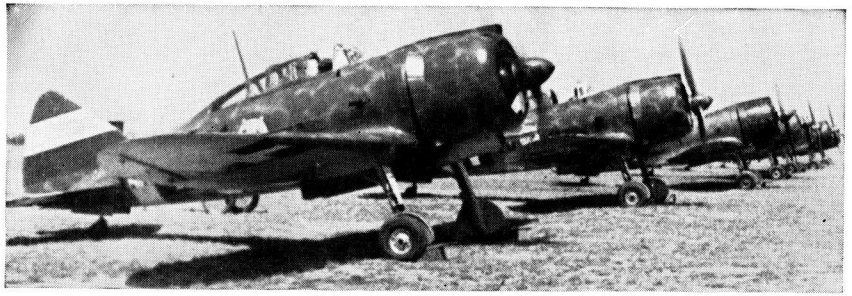
An Re.2000 Serie III° fighter of the 377a Squadriglia which operated from Sicily.





In 1940 the Swedish government placed an order for sixty Re.2000 fighters, these being delivered during the following year and serving with the Flygvapnet as the J 20 until July 1945. The Hungarian government also ordered the Re.2000 and, simultaneously, purchased a manufacturing licence for the aircraft. Named Héjja in the Hungarian Air Force, the first Re.2000s reached Hungary in 1940 and these were employed on the Russian Front. The delivery of Hungarian-built Re.2000 fighters commenced in 1943, these differing from the machines supplied from Italy in having a Manfred Weiss-built Gnôme-Rhône WM K-14 radial of 1,000 h.p. driving a Hamilton Standard airscrew. The WM K-14-powered Re.2000 was 1 ft. 3¾ in. longer than the Piaggio- powered aircraft, but relatively few were completed.

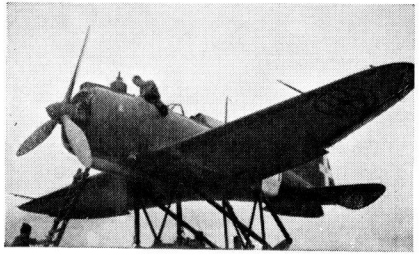
Although the Re.2000 was not adopted by the Regia Aeronautica, the Italian Navy evinced some interest in the fighter, and twelve Re.2000 Serie II° (Catapultabile) were delivered. Powered by the Piaggio P.XIbis R.C.40, these were specially strengthened for catapult launching, and the first trials were conducted in 1942 from the battleship *Italia*. Twenty-four Re.2000 Serie III° (Grande Autonomia) were also delivered, these serving with the 377a Squadriglia based on Sicily and



*Italian-built Re.*2000 *Serie I° fighters of the Hungarian Air Force. The Hungarian-built variant known as the Héjja had a Wright Cyclone engine.*

assigned to the Navy. Similarly powered to the Serie II°, the Serie III° had a modified cockpit canopy generally similar to that of the Re.2001 Falco II, different radio equipment, and increased fuel capacity, the standard tanks being enlarged, a 37 Imp. gal. auxiliary tank being situated aft of the pilot, and attachment points being provided for a drop-tank under the fuselage. These attachment points were sometimes used to carry a 440-lb. bomb. Reggiane completed a total of 170 Re.2000 Falco fighters, the bulk of which were exported to Sweden and Hungary.

*An Re.*2000 *Serie II° employed for catapult trials in* 1942 *from the battleship* Italia.



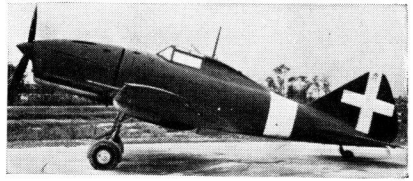
The following specification relates to the standard Re.2000 Serie I°, data in parentheses referring to the long-range Serie III°.

Type: *Single-seat Interceptor Fighter (and Fighter-bomber).* **Power Plant:** *One* 986 (1,025) *h.p. Piaggio P.XI (bis) R.C.*40 *fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 300 *r.p.g.* **Performance:** *Maximum speed,* 329 (326) *m.p.h. at* 16,400 *ft.; cruising speed,* 267 *m.p.h.; range,* 522 (808) *mls.; time to* 19,685 *ft.,* 6 *min.* 10 *sec.* (7 *min.* 45 *sec.*); *service ceiling,* 36,745 (34,448) *ft.* **Weights:** *Empty,* 4,585 (4,607) *lb.; loaded,* 5,722 (6,283) *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.; length,* 26 *ft.* 2½ *in.; height,* 10 *ft.* 6 *in.; wing area,* 219.583 *sq. ft.*

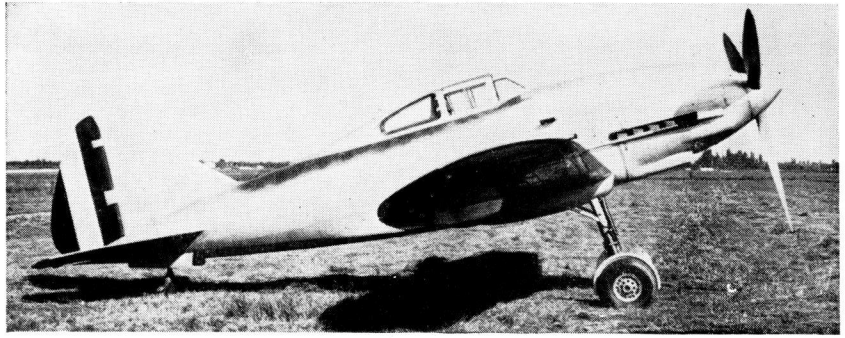
REGGIANE RE.2001 FALCO II

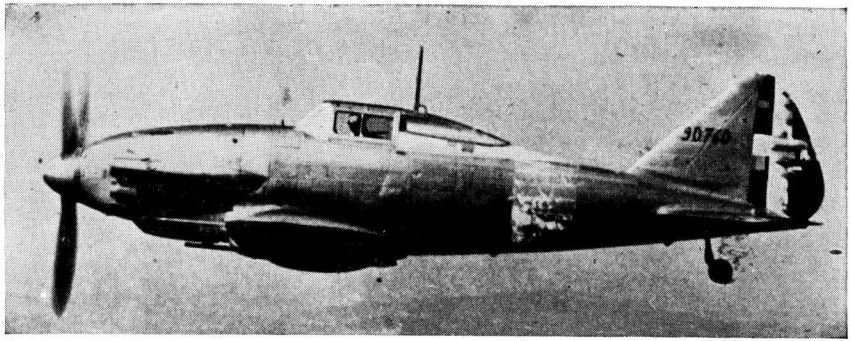
The Re.2001 Falco II was first projected in 1940 as an adaptation of the Re.2000 for the German Daimler-Benz DB 601A-1 liquid-cooled engine, and the first unit to receive the production model, the 2° Gruppo Caccia, received its baptism of fire over Malta in May 1942. Like its predecessor, the R.2001 possessed excellent manoeuvrability, but only 252 examples of this fighter were manufactured owing to the shortage of DB 601A-1 engines and the priority in the supply of these power plants allocated to the superior Macchi C.202 Folgore.

The first production model, one hundred examples of which were built, initially carried two 12.7-mm. Breda-SAFAT machine guns mounted over the engine and firing through the airscrew disc, but these were soon supplemented in the Serie II° and III° by a pair of 7.7-mm. machine guns mounted in the wings, and the Serie IV° was a fighter-bomber adaptation carrying a single bomb of up to 1,410 lb. on a crutch which swung forward to ensure the bomb clearing the airscrew in a diving attack. As an alternative to the bomb, a drop-tank could be carried, permitting the fighter to be used for shipping escort purposes. The principal production model was the Re.2001 CN night fighter, 150 examples of

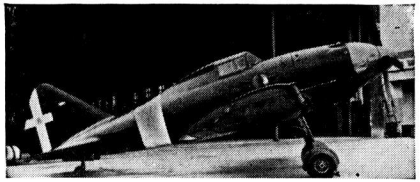


(*Below*) *The first prototype Re.*2001 *Falco II and* (*above, right*) *the Delta IV-powered Re.*2001.

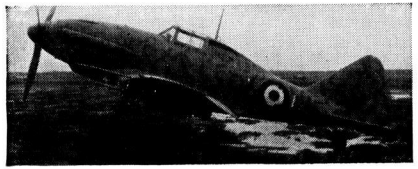




(*Above*) *An Re.*2001 *CN night fighter,* 150 *examples of which were built and* (*below, left*), *an experimental Re.*2001 *with wing leading-edge radiators.*



(*Below*) *An Re.*2001 *CN of the Co-belligerent A.F.*



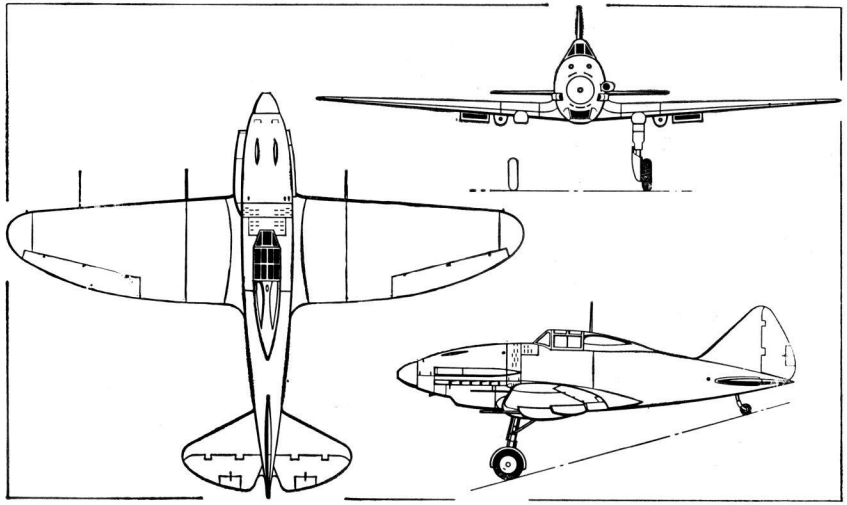
which were built. The Re.2001 CN carried a 20-mm. Mauser MG 151 cannon in a gondola under each wing, and entered service in 1943 with the special night defence force formed in northern Italy to oppose Allied night attacks on industrial centres, and with the Italian armistice and the formation of the Aviazione della RSI under Luftwaffe direction, the Re.2001 continued to fight with the II° Gruppo Caccia.

Several experimental versions of the Re.2001 were built, these including a tandem two-seat model; the Re.2001bis in which the standard underwing radiators were suppressed and replaced by flush leading-edge radiators, and one machine fitted with an air-cooled Isotta-Fraschini Delta IV engine rated at 840 h.p. With this engine, the Re.2001 attained maximum speeds of 252 m.p.h. at sea level and 320 m.p.h. at 14,760 ft. The sole Delta-engined prototype was tested at Guidonia, but during

one flight the engine overheated and caught fire at 26,250 ft., resulting in the destruction of the aircraft. The Re.2001G was an experimental torpedo-fighter conversion; the Re. 2001H was a tank-buster, and two Falco IIs were fitted with deck arrester hooks for trials aboard the aircraft carriers *Aquila* and *Sparviero* which were being converted from merchantmen at the time of the Armistice. Work was actually commenced on an all-wood version of the Falco II. Only 252 Re.2001 fighters were completed.

The following specification relates to the late production day interceptor Re.2001 Serie III°.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,175 *h.p. Alfa Romeo R.A.*1000 *R.C.*41-*Ia Monsonie* (*DB* 601*A*-1) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 350 *r.p.g. and two* 7.7-*mm. Breda-SAFAT guns with* 600 *r.p.g.* **Performance:** *Maximum speed,* 337 *m.p.h. at* 16,400 *ft.*; *climb to* 26,250 *ft.*, 12 *min.* 11 *sec.*; *service ceiling,* 39,200 *ft.*; *range,* 466 *mls. at* 273 *m.p.h. at* 26,250 *ft., or* 646 *mls. at* 233 *m.p.h. at* 19,685 *ft.* **Weights:** *Empty,* 5,500 *lb.*; *loaded,* 7,231 *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.*; *length,* 26 *ft.* 10¾ *in.*; *height,* 10 *ft.* 2¾ *in.*; *wing area,* 219.583 *sq. ft.*



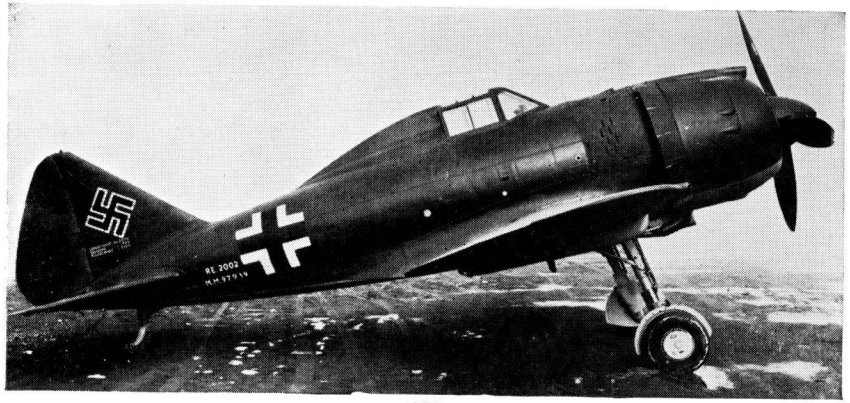
REGGIANE RE.2002 ARIETE

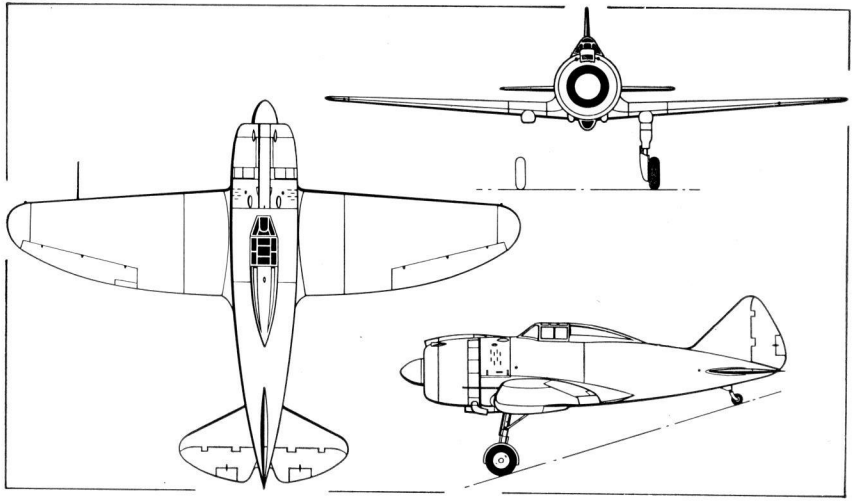
ITALY

Derived from the earlier Re.2000 and Re.2001 Falco series of fighters, the Re.2002 Ariete (Ram) was intended to fulfil the fighter-bomber or assault role, and reverted to an air-cooled radial engine. The Piaggio P.XIX R.C.45 Turbine (Whirlwind) B radial engine was selected owing to its superior characteristics over those of the liquid-cooled engine for the low-altitude attack task, and the need to conserve the limited supply of licence-built DB 601A engines. Several forms of cockpit canopy and engine cowling were tested before the definitive version of the Ariete was evolved. The gun armament of the Re.2001 was retained and the cockpit was generally similar to that of the Re.2000 Serie III°. The cockpit was armoured and a total bomb load of 1,433 lb. could be carried. Tests were also conducted with a torpedo which was carried beneath the fuselage.

The Ariete first entered service in 1942 with the 5° Stormo da Assalto which was largely destroyed in contesting the Allied landings on Sicily. Prior to the Italian Armistice, the 50° Stormo was in process of re-equipping with the Ariete, and this unit subsequently fought alongside the Luftwaffe with the Aviazione della RSI. Only some 40–50 Ariete fighter-bombers were completed. The Re.2002bis was an experimental version of the Ariete in which the rearward-retracting main undercarriage members were replaced by units retracting outwards, this undercarriage later being adopted for use by the Re.2005 Sagittario (Archer).

A number of Re.2002 Ariete fighter-bombers were used by the Luftwaffe in the Balkans.





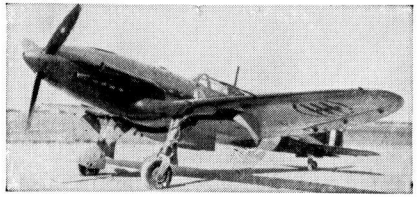
Evolved in parallel with the Ariete were the two-seat Re.2003 reconnaissance bomber powered by a Piaggio P.XIbis R.C.40 radial, two prototypes of which were completed, and the Re.2004 which was to have been powered by a twenty-four cylinder X-type Isotta Fraschini Zeta R.C.25/60 engine but had not been completed when the armistice terminated further development.

Type: *Single-seat Fighter-bomber.* **Power Plant:** *One* 1,175 *h.p. Piaggio P.XIX R.C.*45 *Turbine-B fourteen-cylinder radial air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns* (450 *rounds to starboard and* 390 *rounds to port*) *and two* 7.7-*mm. Breda-SAFAT guns* (350 *rounds to starboard and* 290 *rounds to port*), *and* 1,433 *lb. of bombs.* **Performance:** *Maximum speed,* 267 *m.p.h. at sea level,* 329 *m.p.h. at* 18,045 *ft.; time to* 6,560 *ft.,* 2 *min.* 46 *sec., to* 13,120 *ft.,* 5 *min.* 52 *sec., to* 19,685 *ft.,* 8 *min.* 48 *sec.; ceiling,* 34,450 *ft.; normal range,* 684 *mls. at* 19,685 *ft.* **Weights:** *Empty,* 5,269 *lb.; loaded,* 7,143 *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.; length,* 26 *ft.* 9½ *in.; height* (*tail up*), 10 *ft.* 4 *in.; wing area,* 219.583 *sq. ft.*

REGGIANE RE.2005 SAGITTARIO

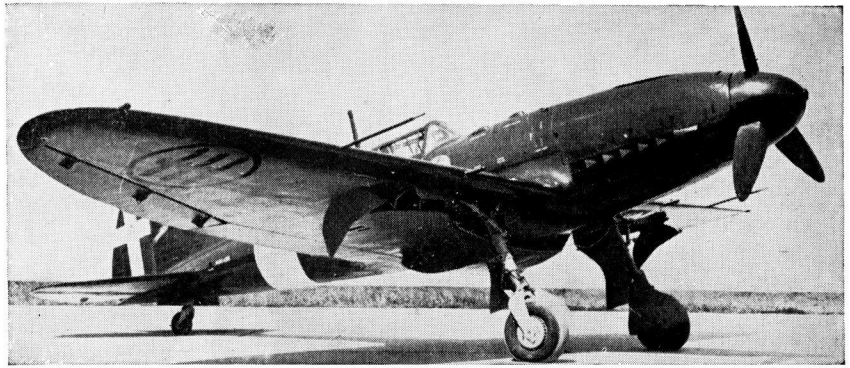
ITALY

One of the best fighters to be produced by the Italian aircraft industry during the Second World War was the Reggiane Re.2005 Sagittario (Archer) which, powered by a Daimler-Benz DB 605A-1 engine, was flown in prototype form (MM 494) for the first time in September 1942. Although the Sagittario possessed the same wing planform as earlier Reggiane fighters, it embodied extensive structural redesign, and employed outward-retracting main undercarriage members which were first tested on the experimental Re.2002bis. Production deliveries commenced in 1943, the production model having a Fiat-built version of the DB 605A known as the Tifone (Typhoon).



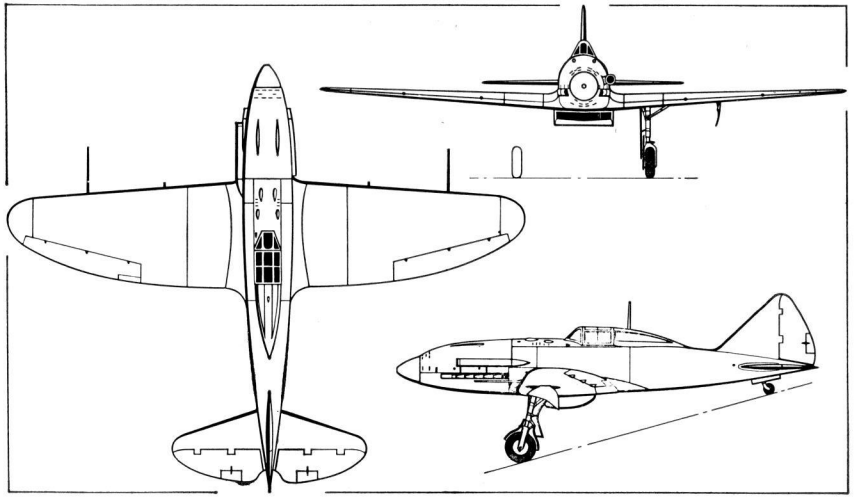
Of the forty-eight Sagittario fighters delivered, the majority were allocated to the 22° Gruppo Caccia which was initially assigned to the defence of Rome and Naples, being based on the airfields of Capua and Capodichino, and one Squadriglia, the 262°, participated in the defence of Sicily. Subsequently serving with the Aviazione della RSI, the Sagittario later participated in the defence of Bucharest and even Berlin. An initial production series of three hundred machines reached an advanced stage, but construction was halted by bombing.

(Above, left) The first and (below) second prototypes of the Re.2005 Sagittario.



Prior to the Italian Armistice, Reggiane was studying the possibility of installing an auxiliary 370 h.p. twelve-cylinder engine in the Sagittario to drive a Campini centrifugal compressor. Designated Re.2005R (the "R" suffix indicating *Reazione*), this version of the Sagittario had an estimated maximum speed of 454 m.p.h.

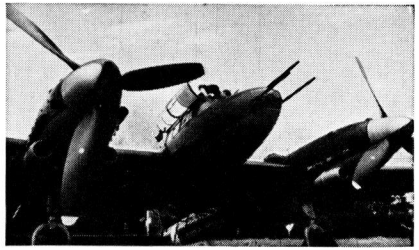
Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,475 *h.p. Fiat R.A.*1050 *R.C.*58 *Tifone (DB* 605*A*-1) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 350 *r.p.g., one engine-mounted* 20-*mm. Mauser MG* 151 *cannon with* 150 *rounds and two wing-mounted* 20-*mm. MG* 151 *with* 200 *r.p.g. Maximum bomb load,* 1,390 *lb.* **Performance:** *Maximum speed,* 390 *m.p.h. at* 22,800 *ft.,* 322 *m.p.h. at* 660 *ft.,* 351 *m.p.h. at* 13,120 *ft.; time to* 6,560 *ft.,* 1 *min.* 58 *sec., to* 13,120 *ft.,* 4 *min.* 4 *sec., to* 19,685 *ft.,* 6 *min.* 33 *sec.; ceiling,* 40,000 *ft.; range,* 787 *mls. at* 320 *m.p.h. at* 21,325 *ft., or* 677 *mls. at* 360 *m.p.h. at* 22,640 *ft.* **Weights:** *Empty,* 5,732 *lb.; loaded,* 7,848 *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.; length,* 28 *ft.* 7¾ *in.; height (tail up),* 10 *ft.* 4 *in.; wing area,* 219.583 *sq. ft.*



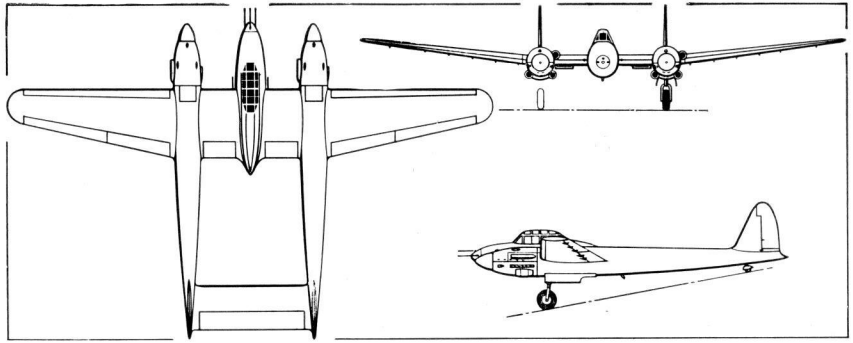
SAVOIA-MARCHETTI S.M.91

ITALY

Although twin-fuselage or twin-boom combat aeroplanes were relatively commonplace during the First World War, the popularity of this configuration languished during the 'twenties and early 'thirties until, in 1936, the Fokker G.I twin-boom fighter-bomber appeared at the Salon International de l'Aéronautique in Paris, and interest in the possibilities of this layout was revived. The twin-boom monoplane never achieved universal acceptance but it offered certain advantages over more orthodox configurations, perhaps the most outstanding example of this arrangement being the Lockheed P-38 Lightning, described in Volume IV.



Among the combatants which examined the twin-boom configuration was Italy, and when, in 1941, the Ministero dell'Aeronautica issued a specification for a two-seat multi-purpose machine suitable for the long-range escort, "destroyer", high-speed reconnaissance, and fighter-bomber roles, two of the competing aircraft manufacturers adopted the twin-engine, twin-boom layout. The specification demanded, among other things, a considerable operational radius coupled with an exceptionally heavy forward-firing armament, and maximum speed and service ceiling comparable with those of the leading contemporary single-engined, single-seat fighters, manoeuvrability being of secondary importance, and the competing aircraft were the heaviest and most powerful fighters evolved by the Italian aircraft industry.



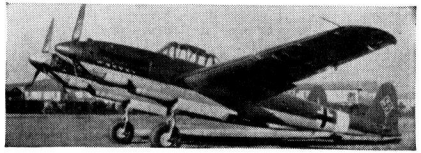
Competing for production orders were the Caproni Aeronautica Bergamasca and the Societa Italiana Aeroplani Idrovolanti "Savoia-Marchetti", the former concern developing the Ca.380 Corsaro and the latter producing the S.M.91 and the S.M.92, all three prototypes being powered by the Daimler-Benz DB 605. The S.M.91, considered as Italy's answer to the de Havilland Mosquito, was flown for the first time on March 10, 1943, and was an all-metal monoplane carrying two crew members in a central fuselage nacelle. An extremely heavy forward-firing cannon armament was installed, and for the fighter-bomber and dive-bomber roles four 220-lb. or 353-lb. bombs could be carried externally, two on racks beneath the central nacelle and two on racks under the wing centre section. Alternatively, a single 1,100-lb. bomb or a 175 Imp. gal. long-range tank could be carried.

Only one prototype of the S.M.91 was completed, and limited flight testing was undertaken with this machine.

Type: *Two-seat Long-range Escort Fighter, Interceptor, and Fighter-bomber.* **Power Plants:** *Two* 1,475 *h.p. Daimler-Benz DB* 605*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Three* 20-*mm. Mauser MG* 151 *cannon with* 300 *r.p.g. in fuselage nose and two MG* 151 *with* 300 *r.p.g. in wing roots.* **Performance:** *Maximum speed,* 363 *m.p.h. at* 22,970 *ft.; cruising speed* (70% *power*), 320 *m.p.h. at* 20,340 *ft.; time to* 19,685 *ft.,* 8 *min.* 30 *sec.; service ceiling,* 36,090 *ft.* **Weights:** *Empty,* 14,110 *lb.; loaded,* 19,599 *lb.* **Dimensions:** *Span,* 64 *ft.* 7½ *in.; length,* 43 *ft.* 5¾ *in.; height,* 12 *ft.* 7½ *in.; wing area,* 449.5 *sq.ft.*

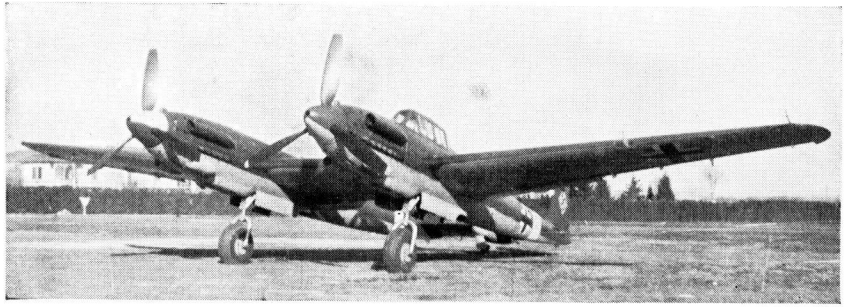
SAVOIA-MARCHETTI S.M.92 ITALY

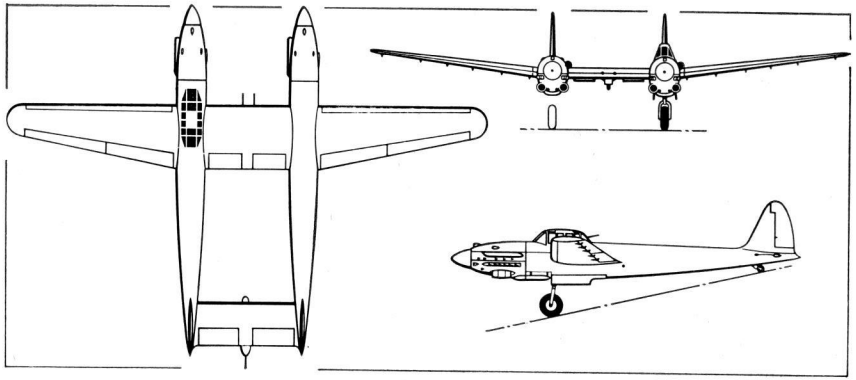
Developed by the SIAI "Savoia-Marchetti" in parallel with the S.M.91, the S.M.92 was intended to meet the requirements of the same official specification which called for a heavy long-range "destroyer" and multi-purpose aircraft. Retaining the basic wing and tail surfaces of the S.M.91, and similarly powered, the S.M. 92 carried its two crew members in the port fuselage boom, this arrangement permitting the elimination of the central fuselage nacelle with a substantial saving in weight and drag. It is of interest to note that a generally similar arrangement to that of the S.M.92 was adopted by its competitor, the Ca.380 Corsaro developed by the Caproni Aeronautica Bergamasca. However, whereas the crew of the S.M.92 was carried in the port fuselage boom, the crew of the Ca.380 was carried in the starboard boom. The Ca.380 prototype, construction of which was still incomplete at the time of the Italian Armistice, was to have carried a forward-firing armament of four 20-mm. Mauser cannon and two 12.7-mm. Breda-SAFAT machine guns. Two bombs weighing up to 1,100 lb. each were to have been carried under the wing centre section.



Like the prototype Ca.380, the prototype S.M.92 was incomplete at the time of the Armistice, but whereas the Caproni fighter was abandoned, construction of the S.M.92 continued, the first test flight being made on November 12, 1943. The proposed forward-firing armament of the S.M.92 comprised two 20-mm. Mauser cannon in the wing centre section, a third 20-mm. cannon firing through the airscrew shaft of the starboard engine, and four 12.7-mm. machine guns, two being mounted beneath each engine. A fifth 12.7-mm. gun was mounted centrally under the tailplane in a remotely-controlled barbette for rear defence.

One of the most unorthodox of Italy's wartime fighters was the twin-boom S.M.92 which flew in November 1943.





Only one prototype of the S.M.92 was completed and flown.

Type: *Two-seat Long-range Escort Fighter, Interceptor and Fighter-bomber.* **Power Plants:** *Two* 1,475 *h.p. Daimler-Benz DB* 605*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Three* 20-*mm. Mauser MG* 151 *cannon with* 300 *r.p.g. and four forward-firing and one rearward-firing* 12.7-*mm. Breda-SAFAT machine guns with* 350 *r.p.g.* **Performance:** *Maximum speed,* 382 *m.p.h. at* 24,935 *ft.; cruising speed* (70% *power*), 335 *m.p.h. at* 22,965 *ft.; time to* 19,685 *ft.,* 7 *min,* 10 *sec.; service ceiling,* 39,370 *ft.* **Weights:** *Empty,* 13,779 *lb.; loaded,* 19,290 *lb.* **Dimensions:** *Span,* 60 *ft.* 10⅛ *in.; length,* 44 *ft.* 11⅓ *in.; height,* 13 *ft.* 7⅛ *in.; wing area,* 414.626 *sq. ft.*

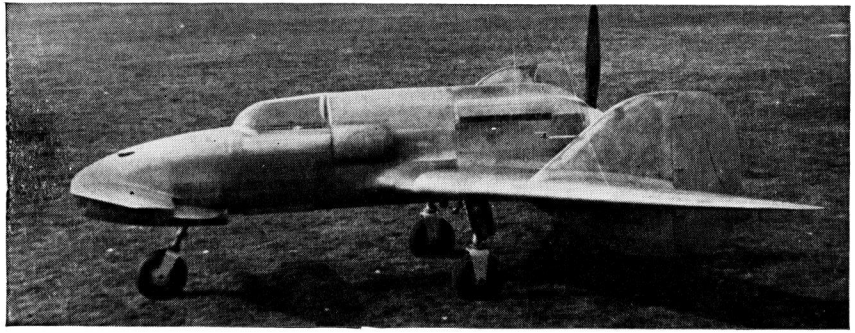
S.A.I. S.S.4

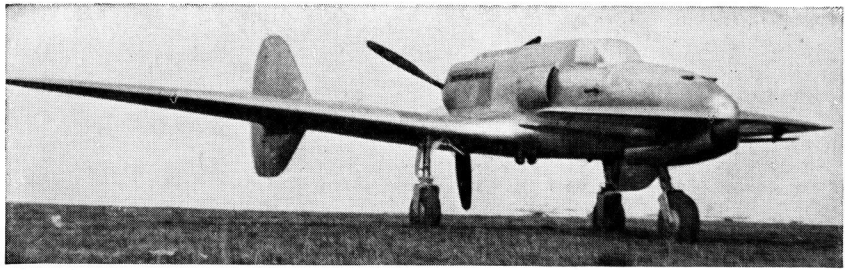
ITALY

The S.S.4 single-seat all-metal experimental interceptor was a singularly advanced aircraft for its time. The world's first combat aircraft to feature a fully retractable tricycle undercarriage with a steerable nosewheel, the S.S.4 also possessed the distinction of being the first warplane of "canard" or tail-first configuration —in which conventional horizontal tail surfaces are supplanted by horizontal control surfaces mounted at the front of the aircraft—to fly. This unconventional arrangement combined with a pusher airscrew was attractive in that it offered the possibility of eliminating airscrew slipstream effects on aircraft drag. It also offered appreciably better visibility than that of a conventional fighter, and facilitated the mounting of a concentrated and heavy forward-firing armament.

The designer, Ing. Sergio Stefanutti, initiated work on the S.S.4 in 1938, having previously gained experience with the tail-first configuration with the S.S.3 Anitra, a tandem two-seat "canard" powered by a 30 h.p. engine. During the mid-'thirties, the S.S.3 made several successful flights between Milan and Rome, demonstrating the aerodynamic efficiency of its unorthodox layout.

The S.S.4 flew for the first time on May 1, 1939, completing an extensive series of flight tests during which it displayed excellent stability and good handling characteristics. Its take-off and landing characteristics were particularly satisfactory, and it was considered that, in addition to its primary role of interception, the S.S.4 would be suitable for dive bombing. While undergoing flight trials at the Guidonia Test Establishment in 1941, the S.S.4 was totally destroyed in an emergency landing necessitated by an engine failure. The Italian Air Ministry ordered the immediate construction of a further prototype, but owing to the priority assigned to the lightweight S.A.I.207 fighter, the further development of the S.S.4 was abandoned.

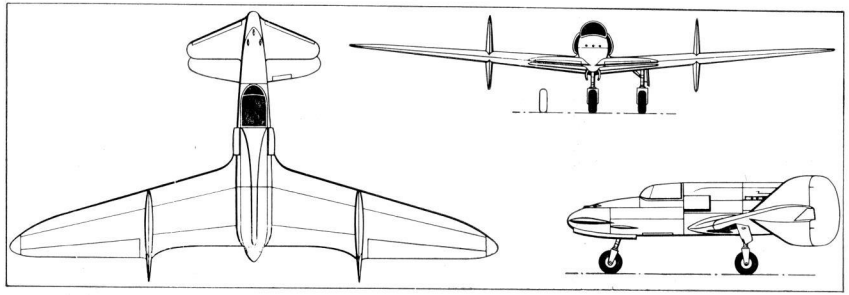




The S.S.4 makes interesting comparison with the Kyushu J7W1 Shinden (Volume III, pages 38–39) and the Curtiss XP-55 Ascender (Volume IV).

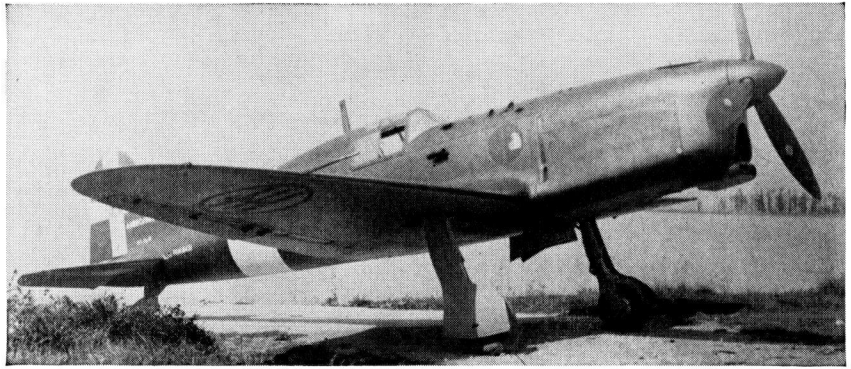
The S.S.4 makes interesting comparison with the Kyushu J7W1 Shinden (pages 38-39 Volume III) and the Curtiss XP-55 Ascender (Volume IV) which, of similar configuration, were evolved subsequently.

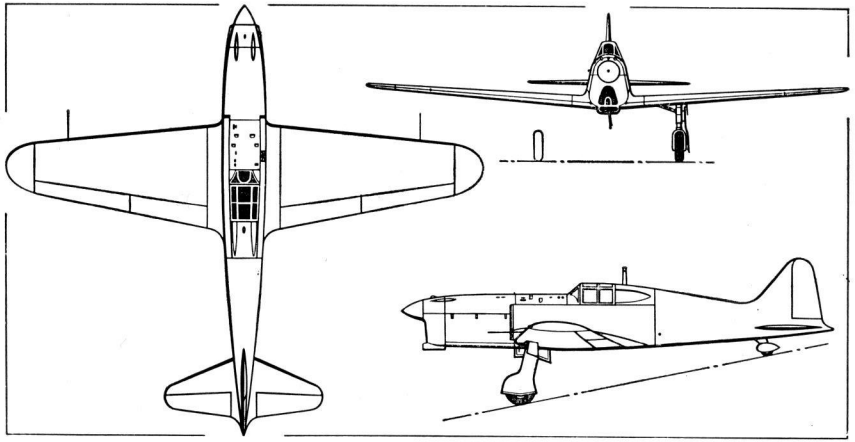
Type: *Single-seat Medium-range Interceptor Fighter and Dive Bomber.* **Power Plant:** *One 960 h.p. Isotta Fraschini Asso XI R.C.40 twelve-cylinder liquid-cooled inverted-Vee engine.* **Armament:** *Two 20-mm. and one 30-mm. cannon.* **Performance:** *Maximum speed, 335 m.p.h. at 16,400 ft. No further details available.* **Weights:** *Normal loaded, 5,401 lb.* **Dimensions:** *Span, 40 ft. 5 in.; length, 22 ft. 1½ in.; height, 8 ft. 1¾ in.*



The potentialities of the wooden lightweight fighter capable of being manufactured rapidly in large quantities without making serious demands on available stocks of strategic materials proved attractive to the aircraft industries of most of the combatants during World War II. Noteworthy examples of combat aircraft of this type were the Bloch MB-700 and Caudron C.714 (pages 35 and 39, Volume I) produced in France; the Miles M.20 (page 90) produced in Great Britain, and the Bell XP-77 (Volume IV) developed in the U.S.A. The Italian aircraft industry was responsible, however, for what were probably the most successful wartime lightweight fighters of wooden construction, but quantity production of these aircraft began too late for them to see operational service.

Ing. Sergio Stefanutti, chief designer of the Societa Aeronautica Italiana Ing. A. Ambrosini of Passignano, commenced work on the design of a lightweight fighter in 1939. Previously, Stefanutti had developed the S.A.I.7 tandem two-seat monoplane which, with a 280 h.p. Hirth H.M.508D engine, had gained the 100-km. closed-circuit record for F.A.I. Category I aircraft with a speed of 244 m.p.h. This impressive performance engendered interest in the S.A.I.7 at the Italian Air Ministry and, accordingly, Stefanutti began developing the basic design for military roles. The second prototype had an orthodox stepped cockpit canopy in place of the long, faired windscreen extending to the front of the engine which had characterised the first prototype, and a 280 h.p. Isotta-Fraschini Beta R.C.10 engine, being intended for use as a two-seat fighter trainer. Simultaneously, a more powerful single-seat variant, the S.A.I.107, was evolved as a test vehicle for the development of the basic design





as a combat aircraft. The S.A.I.107 was flown with a 540 h.p. Isotta-Fraschini Gamma engine and, weighing only 2,200 lb. loaded, attained level speeds in the vicinity of 350 m.p.h. during trials at Guidonia.

In the meantime, work had been proceeding on a single-seat development built to full fighter requirements, the S.A.I.207. Externally similar to the S.A.I.107, the S.A.I.207 was of all-wood construction, the oval-section fuselage being a monocoque with an integral fin and the wing being of two-spar type with plywood skinning. Extensive flight testing was undertaken with the prototypes during which an indicated air speed of 466 m.p.h. was attained in a dive at 10,000 ft. (representing a true air speed of 596 m.p.h., or Mach 0.86). Flown for the first time in 1942, work commenced on a pre-production series of S.A.I. 207, and an order for 2,000 production aircraft was placed by the Italian Air Ministry. In the event, only thirteen pre-production S.A.I.207s were completed, as the production order was superseded by one for the S.A.I.403.

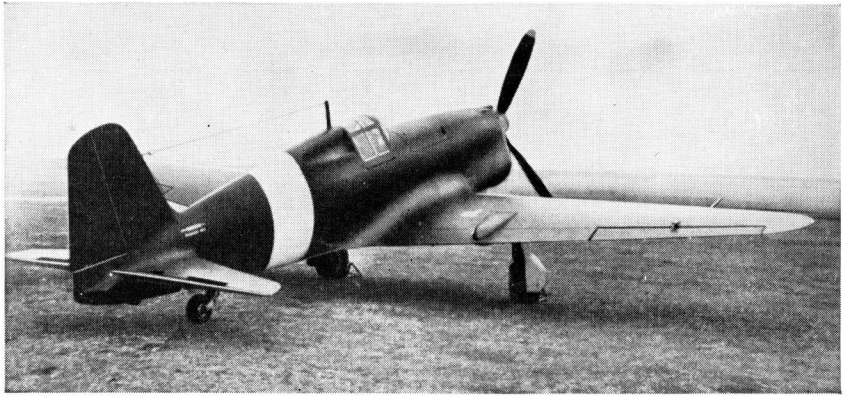
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 750 *h.p. Isotta-Fraschini Delta R.C.*40 *twelve-cylinder inverted-Vee air-cooled engine.* **Armament:** *Two* 20-*mm. Mauser MG* 151 *cannon with* 90 *r.p.g. and two* 12.7-*mm. Breda-SAFAT machine guns with* 175 *r.p.g.* **Performance:** *Maximum speed,* 398 *m.p.h. at* 14,765 *ft.; cruising speed,* 304 *m.p.h.; range,* 528 *mls.; time to* 19,685 *ft.,* 7 *min.* 34 *sec.; service ceiling,* 39,370 *ft.* **Weights:** *Empty.* 3,858 *lb.; loaded,* 5,324 *lb.* **Dimensions:** *Span,* 29 *ft.* 6⅛ *in.; length,* 26 *ft.* 3¾ *in.; height,* 9 *ft.* 5 *in.; wing area,* 149.618 *sq. ft.*

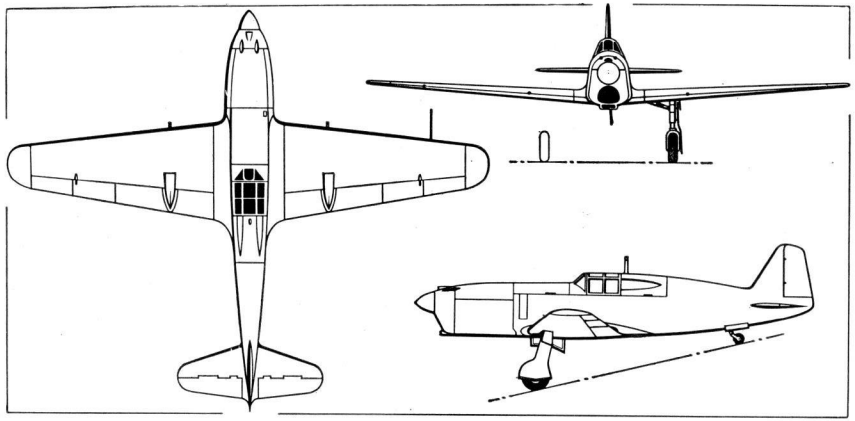
The S.A.I.403 Dardo (Arrow) was essentially a refinement of the S.A.I.207 lightweight fighter, and was of similar wooden construction. A Delta R.C.21/60 Serie I-IV engine driving a three-blade constant-speed v.p. Piaggio airscrew replaced the R.C.40 of the earlier fighter; the tail surfaces were redesigned and the incidence of the tailplane rendered variable in flight; a fully-retractable tailwheel replaced the fixed and faired tailwheel, and internal fuel and ammunition capacities were increased.

Three variants of the S.A.I.403 were studied. The first of these, the Dardo-A, was a light defence interceptor weighing only 5,459 lb. and carrying an armament of two 12.7-mm. Breda-SAFAT guns over the engine with 350 r.p.g. The Dardo-B was a general purpose fighter weighing 5,820 lb. fully loaded and carrying two 12.7-mm. Breda-SAFAT guns with 200 r.p.g. and two 15-mm. or 20-mm. Mauser MG 151 cannon with 200 r.p.g., the latter mounted in the wings, and the Dardo-C was a long-range fighter version with only the wing-mounted cannon and two 33 Imp. gal. underwing drop-tanks supplementing the 90 Imp. gal. internal tankage and increasing maximum range from 800 miles to 1,384 miles. Both "A" and "B" models had an internal fuel capacity of 66 Imp. gal.

The Dardo was an exceptional fighter in several respects, and the prototype, completed late in 1942, possessed excellent handling characteristics and a performance higher than those of most contemporary fighters with twice the power. The structure was sturdy and facilitated mass production, and the use of wood made possible far greater dispersal of production, simplified repairs and conserved stocks of strategic materials. In January 1943 an order was placed by the Italian Air Ministry for 3,000 S.A.I.403 fighters. This order supplanted that previously placed for 2,000 S.A.I.207 fighters, and 1,200 were to be produced by S.I.A.I. "Savoia-Marchetti", 1,000 by Caproni, and the remainder by S.A.I. Ambrosini. Tooling had reached only the initial stages, however, when the armistice terminated all further work on this outstanding fighter.

The first prototype Dardo lightweight fighter, 3,000 *examples of which were ordered.*





The following specification relates to the S.A.I. 403 Dardo-B.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 750 *h.p. Isotta-Fraschini Delta R.C.*21/60 *Serie I-IV twelve-cylinder inverted-Vee air-cooled engine.* **Armament:** *Two* 12.7-*mm. Breda-SAFAT machine guns with* 200 *r.p.g. and two* 20-*mm. Mauser MG* 151 *cannon with* 200 *r.p.g.* **Performance:** *Maximum speed,* 403 *m.p.h. at* 23,620 *ft.; cruising speed,* 304 *m.p.h.; range* (*internal fuel*; 66 *Imp. gal.*), 582 *mls.,* (*with two* 33 *Imp. gal. drop tanks*) 1,164 *mls.; time to* 19,685 *ft.,* 6 *min.* 40 *sec.; service ceiling,* 32,810 *ft.* **Weights:** *Empty,* 4,372 *lb.; loaded,* 5,820 *lb.* **Dimensions:** *Span,* 32 *ft.* 1¾ *in.; length,* 26 *ft.* 10¾ *in.; height.* 9 *ft.* 6 *in.; wing area,* 155.646 *sq. ft.*

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